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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....43, 57
Water Power of the Falls of the Missouri, Great Falls, Mont. (illustrated)..... 44
The Rational Design of Columns (with inset).... 45
A Combined Catch Basin and Manhole for Sewers (illustrated) 46
Rustless Coatings for Iron..... 47
Public Fountains of Filtered Water, Cherbourg, France (illustrated) 48
Notes by Rail (illustrated)..... 49
The Fastest Steamer in the World..... 50
Governor Flower's Order for Sewage Purification Works at Flatbush, L. I..... 50
The Filter Question at Providence..... 55
Do Iron and Steel Crystallize in Service?..... 56
Tie Plate and Fastening for Steel Ties (illustrated) 56
The Haarmann-Vietor Scarfed Rail Joint (illustrated) 57
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS 51
EDITORIAL NOTES 52
The Designer of the Pittsburg Reduction Co.'s Buildings at Niagara Falls—The Status of the Strike—"The Engineer" on the Strike—The Failure of the 17-in. Carnegie Armor Plate—Water Waste in Brooklyn—Low Prices for Street Paving—Omaha Water Power—The Filter Question at Providence, R. I.
EDITORIALS:
The Brockton Sewer Assessment Plan..... 53
Track Elevation in Chicago..... 54
LETTERS TO THE EDITOR.....54, 55
The Use of Coagulants in Mechanical Water Filters—The Philadelphia Asphalt Tests: Correction—A Novel Street Survey Monument—A Mirror on a Locomotive—Bacteria in Drinking Water.
CONSTRUCTION NEWS 58-61
Railways, Street and Electric Railways, Elevated Railways, Highways, Bridges and Tunnels, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Miscellaneous Contracts and Supplies, Condensed List of Contracts Pending with Date of Opening Bids, Contract Prices, Metal Market Prices.
INDUSTRIAL NOTES 62
STOCK AND BOND MARKETS..... 62

The Carnegie 17-in. armor plate took its turn at the Indian Head proving grounds on July 12, receiving two shots from the 12-in. rifle. The first shot penetrated to a depth of 13 ins. The second shot passed entirely through the plate and backing, making a clean hole through the plate without causing any cracks. Thus the plate showed a remarkable toughness, but appeared to be deficient in face hardness.

The proposal to place a pier in the North River is being fought by the New York Chamber of Commerce before the board of expert engineers appointed to consider the plans of the New York & New Jersey Bridge Co. It is proposed to put a pier 900 ft. from the Jersey shore, as the company claims that a span between the present pier lines of the river would necessitate the construction of a suspension bridge, while the company prefers the cantilever type. Mr. Wm. Hildenbrand, who was Mr. Roebling's principal assistant during the construction of the Brooklyn suspension bridge, has presented to the board (on behalf of the Chamber of Commerce) estimates and calculations showing the practical and financial possibilities of the suspension type of construction.

The track elevation ordinance modified to embrace the changes asked by the Lake Shore & Michigan Southern and Chicago, Rock Island & Pacific railways has passed the Chicago City Councils. As modified, the ordinance is mandatory and requires these two companies to elevate their tracks by Aug. 1, 1899, and specifies the terms and conditions upon which the elevation shall be made. One of these stipulations is that the railway companies shall pay to the city $100,000 in lieu of land damages. Another is that the companies shall pave with vitrified brick on a 9-in. bed of cement all the subways, build cement sidewalks, and light all subways with electric lights and remove all the sewers and water pipes to a brick conduit, build compressed air pumps to pump out the surface water, and operate them at their own expense. The average elevation is 1½ ft. higher than in the original ordinance (Eng. News, April 26, 1894), and the depth of the subways is correspondingly less. After a conference with the railroad officers in which they agreed to accept the ordinance and begin work under it within 30 days, Mayor Hopkins signed the measure on July 12.

The triple-screw cruiser "Minneapolis" attained a speed of 25.2 knots during her trial trip of 88 miles at sea, and her average speed was 23.073 knots. She is practically identical with the "Columbia," but has a larger heating surface, and greater bunker capacity. The guaranteed speed was 21 knots, and her speed between the marking buoys on the course was from 21.84 to 25.2 knots.

Chicago has granted a franchise to the Universal Gas Co. to lay mains in all the streets and alleys of the city, under condition that gas shall be sold at not more than $1 per M. ft. and that 10% of the receipts of the company shall be paid into the city treasury.

The Halsted St. lift bridge over the Chicago River suspended operations on July 16. The span was being hoisted with a half-dozen men on it, and when near the top a cogwheel in the gearing which operates the winding drums of the bridge gave way and the span remained stationary at an elevation of about 140 ft. The men on the span were unwilling to attempt to climb down on the ladder attached to the tower and spent the night on the span. The bridge is designed to be moved by hand power in case of the failure of the steam machinery; but the gear wheel which failed apparently disabled the hand machinery as well. The bridge was illustrated and described in our issue of April 19, 1894.

The two most serious railway accidents of the week (as well as a number of minor derailments and collisions in several parts of the country) were directly due to malicious and criminal work of railway strikers and the roughs who pose as "sympathizers" with the strike. Near Oakland, Cal., on July 11, a Southern Pacific Ry. train carrying the United States troops was derailed at a trestle and the engine and four cars went down the bank. Four men were killed and four more were seriously injured. The spikes had been pulled and splice bars taken off by the strikers.——On July 13 an express train on the Cleveland, Cincinnati, Chicago & St. Louis Ry. was turned onto a sidetrack at Fontanet, Ind., by a switch which the strikers had opened. The engine, mail car and two express cars went over the bank, but the sleeping and day cars remained on the rails. The engineman and fireman were killed.

Lawlessness of a similar kind is being carried on in Oklahoma by people who wish to force the Chicago, Rock Island & Pacific Ry. to build stations and stop trains at South Enid and Pond Creek. The throwing of the track at the latter place was described in our issue of June 21, and since then trains and bridges have been wrecked by dynamite, trestles burned and track torn up.

Several earthquake shocks have occurred in Turkey, Constantinople being the chief city to suffer. The shocks occurred from July 10 to 12, and over 150 persons were killed by falling buildings.

The Toronto Board of Works has voted in favor of an expenditure of $20,000 for the investigation of a gravity water supply from Lake Simcoe, the southern end of which is some 50 miles from Toronto. Mr. E. H. Keating is city engineer of Toronto and has recommended, according to reports, that the supply from Lake Ontario should be continued. To secure pure water from the lake Mr. Keating favors a tunnel beneath the bay, in place of the present conduit, and a new conduit across Toronto Island and into the Lake. It is believed that the present conduit admits impure water from the harbor, and in addition more water is or soon will be needed than can be furnished by the present conduit.

The Board of Health of New Orleans has passed a resolution urging the City Council to prohibit "the building of any more roads, whether for streets or car tracks, with wooden material." This action is taken on the ground that decaying wood is injurious to health. The damp climate and saturated soil of New Orleans make wooden paving blocks decay much more rapidly than in Northern cities.

A franchise for an underground loop line to connect the downtown terminals of the Chicago elevated railways, is asked of the Chicago City Councils by the Chicago Subway, Arcade & Traction Co. The loop is to lie within the district bounded by 12th, Kinzie and Clinton streets and Lake Michigan, and the ordinance provides that the material removed is to be used to fill the submerged land between the Illinois Central right of way and a dock line to be established by the United States Government, thus adding to the Lake Front park. The subways are to be in the clear not less than 18 ft. in width, and not less than 13 ft. in height, and as near to the surface as may be deemed practicable. Upon the bottom is to be a flooring of concrete of a thickness of 3 ft., more or less. The subways are to be inclosed on the sides by walls of sufficient strength, the roof to be of steel, which will form the foundation of the street pavement. Below this is to be an air chamber for conduits, wires and pipes. Tunnels under the river are to be of steel and not interfere with navigation. Plans must be approved by city officials and work is to be done under their supervision. All damages to abutting property are assumed by the projectors. Water, sewer and gas pipes, telegraph, telephone and electric light wires are not to be unnecessarily interfered with and if removed must be relaid at the company's expense. Lifts or stairways leading from the street to the subways are provided for, stations to be in basements of such abutting buildings as may be leased or purchased. A 2-cent fare is the maximum that may be charged with transfers on all roads using the subway, and 2% of the gross earnings are to be paid annually to the city. Work must begin within one year from the passage of the ordinance, and must be completed within five years thereafter. The ordinance will not become effective until the company shall execute to the city a bond of $100,000, 90 days to be given for the acceptance of the measure.

Sheet or block asphalt paving has been recommended for use in Hartford, Conn., by a special committee on street paving, which has visited a number of cities on an investigating tour. Mr. Chas. H. Northam is president of the street commissioners.

A change in the location of a part of the Salt Lake gravity outlet sewer (Eng. News, Jan. 4, 1894) is proposed with a view of shortening its course 800 ft. and saving some cuts. About $175,000 of work has thus far been done on the sewer.

An attempt to limit the amount of water which may be diverted from the Niagara River at the Falls is being made through the New York Constitutional Convention. It is said that four companies have rights or claim rights to take water from above the falls, as follows: The Niagara Falls Power Co., which is limited to the diversion of water for 200,000 HP.; the Niagara Falls Hydraulic Power & Manufacturing Co., which takes water as riparian owners; Love's Model City Co., known also as the Niagara Power & Development Co., and the Niagara, Ontario & Lockport Co., whose project is known as the Lockport canal scheme. Only the charter of the first named company specifies how much water may be diverted. The above list does not include the several schemes for power development on the Canadian side of the river.

Cleveland, Detroit and Milwaukee are each adding greatly to the efficiency of their fire protection systems by laying fire mains from their respective water fronts into the business districts, so that the fireboats can be connected and can assist the street fire engines. In Milwaukee 13,731 ft. of 10-in. fire pipe is being laid this season. The Cleveland system was described in our issue of Jan. 5, 1893, and the Detroit system, June 21, 1894, in the report of the proceedings of the New England Water-Works Association.

Six new pumping engines and 6,000 ft. of lake tunnel extension are proposed for the Chicago water-works, the cost of these, and possibly some other improvements, being estimated at $1,200,000. Four of the engines are to have a capacity of 15,000,000 gallons each and two a capacity of 12,000,000 gallons. One of the larger engines is designed for the Lake View station, two for the Chicago Ave. station, to replace old engines, and one for the 14th St. station. The two smaller engines are to be placed at the 68th St. station. The lake tunnel will connect the old shore inlet at the Chicago Ave. station with the two-mile crib.

The new steel bridge over the Willamette River at Burnside St., Portland, Ore., has been completed. It is 1,621 ft. long, with a pivot pier for the drawspan, two side piers and two abutments. The roadway is 32 ft. wide, with two sidewalks, each 7 ft. wide. The pivot-pier is founded on piles and grillage, and the turntable of the span is 43 ft. diameter. W. B. Chase, of Portland, Ore., was the engineer, and Bullen & Co. were the contractors.

A four-track drawbridge with plate girders 176 ft. long is being built by the New York, New Haven & Hartford R. R. across the Bronx River, near New York city. The draw has but one arm, the turntable being on the south abutment.

The American Asphalt Paving Co., through its receiver, General Anson G. Cook, has brought suit against the Barber Asphalt Paving Co., for alleged infringement of the patent granted to William W. Averill, in January, 1878, for a style of pavement which had already been laid on Pennsylvania Ave., in Washington, D. C.

Car fenders must be fitted to the electric cars of Newark, N. J., by October next, in accordance with a recent ordinance of the city councils.

The water power of the falls of the Great Kanawha, near Charleston, W. Va., is proposed to be developed for electrical purposes by a company just organized at Charleston. Mr. O. A. Patton, of Charleston, is one of the incorporators.

The Pennsylvania R. R. Co.'s general offices have been removed to the new Broad St. Station in Philadelphia.

An investigation of meters used by electric lighting companies in Massachusetts is to be made by the Board of Gas and Electric Light Commissioners of the state, in accordance with a recent act of the legislature. A report on the subject will be made to the legislature at its next session.

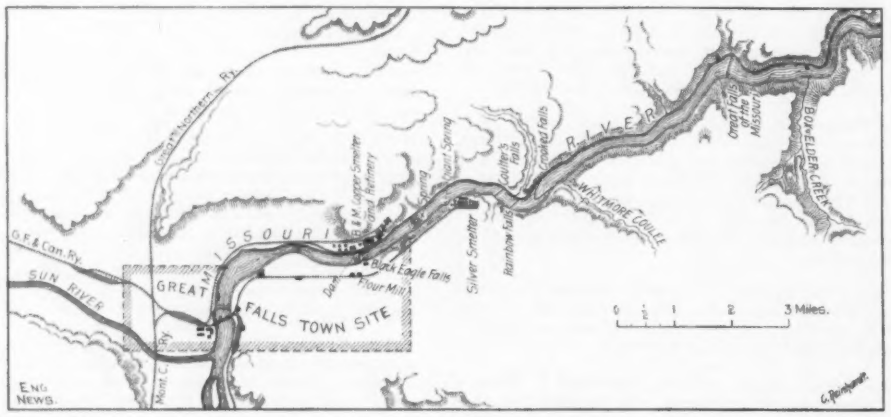
WATER POWER OF THE FALLS OF THE MISSOURI, GREAT FALLS, MONT.

By M. S. Parker, M. Am. Soc. C. E.

The progress that is being made in electrical development at the present time is bringing the water powers of our country into a prominence hitherto unknown. Small water powers which have long lain idle and undeveloped ate now being rapidly developed. With the perfection of the devices for long-distance transmission and storage of electricity, every available water power in the country will be utilized to its fullest capacity in the near future.

Niagara, with its immense volume of water power, is destined to reach enormous importance in the commercial world. Probably the present generation will see its power distributed over all Northern New York. Among the large water powers of the United States, the "Falls of the Missouri River," in Montana, undoubtedly rank second to Niagara.

The full development of this great water power will be far slower than the development of that of Niagara, for the country surrounding it is not so thickly settled. The city of Buffalo, N. Y., has a greater population than the entire state of Montana, with its 145,310 sq. miles of area. The population of Montana is about 200,000 at present. (In 1890 the population of Buffalo was about 250,000 and of Montana 130,000.)



MAP SHOWING THE FALLS OF THE MISSOURI RIVER NEAR GREAT FALLS, MONTANA.

The accompanying map shows the location of the principal cataracts which constitute the great falls of the Missouri River. Their names in the order in which they occur following down the river from the Great Falls townsite are, Black Eagle, Coulter, Rainbow, Crooked and Great Falls. Between these falls are series of rapids capable of developing into what would be considered large powers in sections of the country less favored by nature with respect to water power.

Table I. gives distances and elevations from the head of the first rapid at the Great Northern Ry. bridge to the small town of Fort Benton, the head of navigation of the Missouri River. Table II. gives the volume of water flowing over the crest of Black Eagle Falls dam from May, 1891, to March, 1894. There are large springs between Black Eagle and Rainbow Falls, which increase this flow approximately 700 cu. ft. per second. This has been determined by gaging the river at the points mentioned. The Giant Spring, so called, on the left bank of the river, is a remarkable phenomenon. It gushes out of the rocks in a living torrent. Lewis and Clarke refer to it as a large fountain. Not far from this spring is another in the middle of the river, boiling up through crevices in the rocks, and apparently of equal proportions. The flow from these springs is sufficiently great to modify the temperature of the water in the river to such an extent that ice rarely forms in the river at Rainbow Falls even in the coldest weather. The absence of ice at Rainbow Falls during weather when the Black Eagle Falls, only 5½ miles above, are entirely enveloped in ice from the crest of the dam to the foot of the falls, is frequently remarked. Owing to this fact the Rainbow Falls is the best site for developing power along the whole series of cataracts. Ice is a source of great annoyance in the use of water power, especially anchor ice, as all who have had anything to do with water power in northern latitudes can testify.

The Black Eagle Falls development is referred to by the writer in a paper published in the Transactions of the American Society of Civil Engineers, Vol. XXVII., July, 1892. I quote from a report recently made to the owners of the water power—the Great Falls Water Power & Townsite Co.—as follows:

> From the records I have kept, and from my observations of the river at Great Falls for the past four years, I am of the opinion that the minimum flow of the river at Black Eagle Falls can be safely placed at 3,496 cu. ft. per sec., etc.

This flow can be taken as constant. The occasions when the flow is less are from causes which cannot be taken into consideration in estimating the available power. The supply of water in the river is constant, but it is affected at times by natural causes incident to this latitude.

The crest of the dam at Black Eagle Falls is level and is 747 ft. long. It is rounded and has an iron plate 4 ft. wide fitted to a curve of 4 ft. radius. The slope on either side of the curve is 0.3 to 1. In gaging the flow (see Table II.) allowance was made for the water consumed by the wheels in operation. The flow was calculated from the formula of J. B. Francis. The coefficient 3.33 was used up to 2 ft. head on the crest, and 3.3 above 2 ft. head.

Black Eagle Falls, under present development, has a head of 40 ft. The minimum gross horsepower under this head for 3,496 cu. ft. per sec. is equal to 15,840. The dam at this point is so constructed that its crest can eventually be raised 10 ft., adding thereby 3,168 HP.

With a dam of 14 ft. in height at Rainbow Falls water could be backed up to a level with the crest of Coulter Falls. There remains, however, 40 ft. fall between the foot of Black Eagle Falls and this point, which is capable of development, and would give a power equal to the present developed power at Black Eagle Falls.

The Rainbow Falls is the queen of all the falls for beauty, as well as the most favorably situated for power development. Rainbow and Crooked Falls can be considered as one for power purposes. They are close together, and the head can be either utilized entire or divided. The sheer fall of the first mentioned is 37 ft. From elevations in Table I. it will be seen that a total head of 82 ft. can be obtained from the crest of Rainbow Falls to a point below Crooked Falls; with a dam 14 ft. in height the head obtained is 96 ft. The flow at this point is increased by the additional 700 cu. ft. mentioned before, contributed by springs. This, added to the constant minimum flow at Black Eagle Falls of 3,496 sec.-ft., equals 4,196 sec.-ft., equivalent to 45,628 gross HP. available at Rainbow and Crooked Falls.

From the point below Crooked Falls to the crest of the Great Falls there is a fall of 145 ft. in a distance of nearly 3½ miles. This is capable of development, but at much greater expense than at the natural falls of the river.

The Great Falls have a sheer drop of 75.4 ft., and 100 ft. can easily be obtained by the use of a dam 12 ft. in height located 300 ft. above the crest, as the river bed falls rapidly as it nears the crest. This is an ideal water power, especially for electrical purposes. Here we have, with the same volume of water as stated above, 47,518 HP. gross available.

From the Great Northern Ry. bridge, the point from which the distance shown in Table I. are measured, the entire fall of the river to the foot of the Great Falls is 409.8 ft. Continuing on down the river to a point opposite the Belt Creek, a distance from the Great Falls of about five miles, we have a total fall of 502.4 ft. From this point to Fort Benton, the head of navigation, the river falls rapidly, and the total fall from the head of the rapids at the Great Northern Ry. bridge to Fort Benton, a distance of 41½ miles, is 677.7 ft.

Estimating the total available gross horse power of the three great falls, viz., the Black Eagle Falls, the Rainbow and Crooked, and the Great Falls, we have, based on the foregoing suggested improvements and under the constant minimum flow of water mentioned, a total of 112,154 gross HP.

The head consumed in acquiring this power is 246 ft. This from the total head between the railway bridge and foot of the Great Falls, namely, 409.8 ft., leaves 163.8 ft. to be drawn upon after the three great powers have been utilized. The above mentioned head of 163.8 ft. would add 77,850 HP. Hence the total possible power which could be derived by utilizing the entire capacity of the Falls of the Missouri under the minimum volume of water flowing as before mentioned, is 190,000 gross HP.

TABLE I.—Elevations of Water Surface of the Missouri River, between the Great Northern Ry. Bridge at Great Falls, Mont., and Points Below Reduced to 0 of the Government Gage at Fort Benton, Survey, 1890.

0 Ft. Benton gage = 2,602.0 ft. reduc'd to N.P.Ry. data.
0 " " " = 2,609.7 " " " G.N. Ry. "

Places.	Distances between points mentioned, ft.	Total distance from G. N. Ry. bridge, ft.	Elevations, ft.	Fall between points named, ft.
G.N.Ry. bridge, head of rapids	0	0	3,294.7	...
Ab've Black Eagle Falls dam.	14,300	14,300	3,282.9	11.8
Below " " " "	3,400	17,700	3,240.6	42.3
Above Coulter Falls.....	14,750	32,450	3,201.5	39.1
Below " "	100	32,550	3,194.8	6.7
Above Rainbow Falls.....	1,100	33,650	3,187.5	7.3
Below " "	200	33,850	3,150.6	36.9
Above Crooked Falls.....	600	34,450	3,143.8	6.8
Below " "	2,650	37,100	3,105.9	37.9
Above Great Falls.....	18,850	55,950	2,960.3	145.6
Below " "	100	56,050	2,884.9	75.4
Mouth of Belt Creek.....	25,100	81,150	2,792.3	92.6
Ft. Benton, head navigat'n.	138,050	219,200	2,617.0	175.3

Total fall of 677.9 ft. in 41½ miles.

TABLE II.—Flow of Water in Missouri River over Crest of Black Eagle Falls Dam.

Date.	Gage reading, head on dam crest, ft. Min.	Max.	Cubic feet per second. Min.	Max.	
1891.					Crest of dam level and 747 ft. long.
May	2.34	3.35	8,291	15,126	Crest of dam is rounded with iron plate 4 ft. wide fitted to curve of 4 ft. radius. Slope, either side of curve, 0.3 to 1.
Jun.	3.06	4.70	13,520	25,020	
July	2.10	5.00	7,470	27,200	
Aug.	1.35	2.65	3,904	10,507	
Sep.	1.15	1.35	3,077	3,904	
Oct.	1.32	1.40	3,362	4,110	
Nov.	1.00	1.65	2,487	5,266	
Dec.	0.90	1.55	2,121	4,795	
1892.					
Jan.	0.90	1.40	2,121	4,110	Allowance made in gage reading for water consumed by wheels in operation.
Feb.	1.33	1.75	4,110	5,705	
Mar.	1.50	1.90	4,564	6,513	
Apr.	1.50	1.70	4,564	5,505	
May	1.65	4.60	5,266	24,281	Flow calculated from formula of J. B. Francis. Coef. 3.33 is used up to 2 ft. head on crest and 3.3 above 2 ft. head.
Jun.	3.50	8.00	16,135	55,760	
July	1.86	5.80	6,270	34,018	
Aug.	1.45	2.00	4,337	7,036	
Sep.	1.35	1.50	3,904	4,564	
Oct.	1.35	1.55	3,904	4,795	
Nov.	1.40	1.50	4,110	4,564	
Dec.	1.20	1.75	3,272	5,705	
1893.					
Jan.	1.20	1.70	3,272	5,505	
Feb.	1.20	1.75	3,272	5,705	
Mar.	1.45	2.60	4,337	10,308	
Apr.	1.56	2.60	4,841	10,308	
May	1.75	4.60	5,705	24,281	
Jun.	3.50	5.20	16,135	29,215	
July	1.78	3.80	5,825	18,226	
Aug.	1.38	1.72	4,017	5,585	
Sep.	1.36	1.62	3,955	5,123	
Oct.	1.66	1.84	5,314	6,150	
Nov.	1.87	2.00	6,331	7,036	
Dec.	1.86	1.95	5,410	6,775	
1894.					
Jan.	1.15	1.80	3,077	5,905	
Feb.	1.38	1.55	4,017	4,795	

THE RATIONAL DESIGN OF COLUMNS.

(With Inset.)

By Prof. Mansfield Merriman, M. Am. Soc. C. E.

The rational investigation of a given beam or column under assigned loads is the determination of the internal unit-stresses in any or all its parts, and the comparison of these with the elastic and ultimate strength of the material. Rational design is the determination of proper dimensions for the beam or column, the permissible unit-stresses being first assumed with reference to the known properties of the material. Rational investigation and design imply and require correct theories for their application; and furthermore, these theories must be expressed by formulas or rules which are not tedious or impracticable in computation.

The Theory of Beams.

The theory of the flexure of beams within the elastic limit of the material has long been known, while that of flexure beyond the elastic limit is not yet perfected, for the reason that no theoretical relation between stress and deformation has been discovered. It has hence always been customary to use the theory of flexure within the elastic limit for cases of rupture, the stresses in this case being fictitious rather than real, since the formulas are empirical rather than rational. Thus arose the modulus of rupture, a quantity intermediate between the tensile and compressive strengths of the material, and which has no rational or theoretical significance.

The practice of testing beams to destruction and the accompanying use of a factor of safety as a basis for designing, reacted upon the theory of flexure within the elastic limit and greatly retarded the advance of rational methods. Witness, for example, the books of Barlow, Tredgold and other British writers of 50 years ago, in which everything is based upon the conditions of rupture, and in which the elastic limit of materials is scarcely mentioned. Or, for a modern instance, witness Trautwine's Engineers' Pocket Book, in which these old empirical methods are still given, coefficients taken from tables, breadth and depth of beam in inches, length in feet, being directed to be multiplied and divided into each other, and one-sixth or one-fourth of the result taken as a safe limit. Similar empirical rules are given in some manufacturers' pocket books, but as a general thing the text-books on the resistance of materials state clearly the rational method for cases of flexure within the elastic limit, showing, however, too strong a tendency to apply it to cases of rupture.

Specifications for structural work now generally imply that rational methods for the investigation and design of beams are as well known as those for members subject only to simple stresses of tension or shear. The permissible unit-stresses being within the elastic limit of the material, it is simply necessary to specify the value which shall not be exceeded under conditions of maximum loading. The well known rational formula for beams is

$$M = \frac{SI}{c}, \quad \text{or,} \quad S = \frac{Mc}{I},$$

in which M is the bending moment of the external forces with reference to any section, S the longitudinal tensile or compressive unit-stress at the distance c from the neutral axis through the center of gravity of the section, and I the moment of inertia of the section with respect to that axis. M can be expressed for any particular case in terms of the loads, and thus for a beam of given dimensions the unit-stress can be computed, or for a given unit-stress dimensions can be proportioned.

The formula just quoted is true when the unit-stress S on the part of the beam furthest from the neutral axis is within the elastic limit of the material. It is not true when this limit is exceeded, because then the neutral axis does not pass through the center of gravity of the cross section, and because also the different longitudinal stresses are not proportional to their distances from that axis, these two requirements being involved in the deduction of the formula. But in all cases of design the permissible unit-stresses should not exceed the elastic limit, and hence the formula applies rationally, without regarding the ultimate strength of the material or any of the circumstances regarding rupture. Indeed so great reliance is placed upon this formula that the practice of testing beams by rupture has been almost entirely abandoned, and the allowable unit-stresses are mainly derived from tensile and compressive tests.

The Theory of Columns.

With regard to columns the case is very different. All of the formulas in use, with one exception, are empirical and mainly derived from the results of experiments and tests which involve rupture. The one exception is Euler's well-known formula for the case of pure lateral flexure, which is applicable only to very long columns, such as are rarely used in engineering structures.

In practice a column is a case of combined compression and flexure and its theory is intermediate between that of a short prism, which is in the condition of pure compression, and that of a long column, which is governed by Euler's formula. But a rational theory has not yet been established, and hence the resort to empiricism. Numerous tests of the rupture of columns have been made during the twenty years, and many empirical formulas have been proposed as a basis of design. These formulas are regarded with the more favor the closer they represent the results of tests, at least each engineer who proposes one rests his case on the close agreement between it and experiment.

A truly rational formula for columns, if such can be established, will probably fail to satisfy this test. Such is the truth with regard to the rational formula for the flexure of beams; although entirely satisfactory when the material is not strained beyond the elastic limit, it does not agree at all with the conditions of rupture, and the unit-stress deduced from it in such cases is neither the tensile nor the compressive strength of the material, but a fictitious value usually intermediate between them. The formula does not agree with rupture, yet it is correct and rational when the elastic limit is not surpassed. When a rational formula for columns is established, it will be analogous to that for beams in this respect. It will be true within the elastic limit, it will not be true beyond it, and it will probably not agree as closely with the records of tests by rupture as many of the empirical formulas now in use. Nevertheless, it will be the one to be used in both investigation and design, and from it the maximum unit-stress, due to an assigned load, can be computed, as is now done in the application of the formula for beams. For a long column, it will reduce to Euler's expression, and for a short prism it will reduce to the simple expression for pure compression.

The specifications now in common use for bridges state the particular empirical formulas to be used for designing compression members. Cooper's specifications for railroad bridges, for instance, give the following for wrought iron posts:

$$B = 7{,}000 - 40\frac{l}{r} \quad \text{for live load strains.}$$

$$B = 14{,}000 - 80\frac{l}{r} \quad \text{for dead load strains.}$$

$$B = 10{,}500 - 60\frac{l}{r} \quad \text{for wind strains.}$$

In which B is the load per square inch of cross section, l the length of the member, and r the least radius of gyration of the cross-section. These formulas, although excellent for computing proper safe loads, are unsatisfactory from a rational standpoint, because it is quite impossible to derive from them the unit-stress caused by a given load. In fact, this is a defect common to all column formulas—including that of Euler—that the unit-stress in the column at the dangerous section does not occur in the expression in such a way that it can readily be deduced, or if it can be deduced there is no reliance to be placed upon it, because the formula has little theoretical basis.

When the true theoretical column formula is established it will be unnecessary to state it in a specification, but as is now done for beams, a simple requirement like the following will be alone needed: "The maximum unit-stress on the column shall not exceed, for wrought iron, 8,000 lbs. per sq. in. under the action of live loads, and 16,000 lbs. per sq. in. under dead loads."

A Rational Formula for Columns.

The following column formula is presented as a very close approximation to a true rational one: Let B be the unit-load on the column, found by dividing the total load by the area of the cross section. Let C be the maximum compressive unit-stress on the concave side of the column. Let l be the length of the column and r the least radius of gyration of the cross-section. Then the formula is,

$$C = \frac{B}{1 - \frac{n\,B}{\pi^2 E} \cdot \frac{l^2}{r^2}} \qquad (1)$$

in which, as usual, π is 3.1416, E is the coefficient of elasticity of the material, and n is a number depending on the arrangement of the ends of the column; for both ends round $n = 1$, for one end round and one fixed $n = 4 \div 9$, and for both ends fixed $n = \frac{1}{4}$. From this formula the unit-stress C, due to a given load, can be computed, provided that it is less than the elastic limit of the material.

Demonstration.

The following is a brief outline of the method of establishing this formula, it being thought unnecessary to give the algebraic work in full:

The general reasoning of Gordon and Rankine is regarded as correct. This leads to the expression,

$$B = \frac{C}{1 + q\frac{l^2}{r^2}}$$

in which q and C are usually derived by experiment, although it is known theoretically that q varies as the numbers 1, $4 \div 9$ and $\frac{1}{4}$ for the three different conditions of ends.

The reasoning of Euler for long columns is also regarded as correct. This leads to the expression,

$$B = \frac{\pi^2 E}{n} \cdot \frac{r^2}{l^2},$$

in which E is the coefficient of elasticity of the material, and n has the three values already stated.

Now a true rational column formula must embrace both these cases. For a long column, where r is very small with respect to l, it should reduce to Euler's expression. For a short block or prism where l is small with respect to r, it should reduce to $B = C$, or the unit-load equals the unit-stress.

Let, then $\frac{l}{r}$ be regarded as the abscissa of a curve and be denoted by x, and let the unit load B be the ordinate and be denoted by y. Thus the formulas of Rankine and of Euler may be written,

$$y = \frac{C}{1 + q\,x^2} \quad \text{and} \quad y = \frac{\pi^2 E}{n\,x^2}.$$

Now, in order that these two formulas may be combined into one, the curves represented by these equations must be tangent to each other, and this condition will determine the value of q. For the point of tangency the two ordinates are equal, and also the two derivatives of y with respect to x. The two derivatives are

$$\frac{dy}{dx} = -\frac{2\,C\,q\,x}{(1 + q\,x^2)^2} \quad \text{and} \quad \frac{dy}{dx} = -\frac{2\,\pi^2 E\,x}{n\,x^4}.$$

Placing equal to each other the two values of y and also the two values of $\frac{dy}{dx}$, and solving for x and q, there is found,

$$x_1 = \infty \text{ and } q = \frac{n\,C}{\pi^2 E}.$$

The point of tangency, therefore, is when l is infinite with respect to x, and for this point the ordinate $y_1 = 0$.

The value of q being now determined, its insertion in Rankine's expression gives the formula,

$$B = \frac{C}{1 + \frac{n\,C}{\pi^2 E} \cdot \frac{l^2}{r^2}} \qquad (2)$$

from which the formula (1) is readily deduced by solving for C.

Discussion of Formula.

The formula here deduced is called rational, because in all the reasoning the laws of the resistance of materials within the elastic limit have been regarded, and because it unifies the rational theories of long and short columns. It is not necessarily correct when the elastic limit of the material is exceeded by the unit-stress C, and no attempt will

here be made to justify it by comparison with the results of tests to destruction; applied to such cases it would, like the rational formula for beams, be merely empirical.

For most practical cases in bridge and building construction the mean values of E may be taken as follows, in pounds per square inch:

For timber	E = 1,500,000.
For cast iron	E = 15,000,000.
For wrought iron	E = 25,000,000.
For steel	E = 30,000,000.

It will always be close enough to take π^2 as 10. These values will be used in the following numerical work.

There is, of course, no distinct line of demarcation between the case of pure compression and that of a short column in which lateral flexure begins to have a slight influence. The proposed formula shows that in perfect strictness pure compression only occurs when $l = 0$, or when l is infinitely small with respect to r; for this case the unit-stress C equals the unit-load B. Yet, practically, l can be considerably larger than r before C exceeds B by an appreciable amount. For example, take the case of wrought iron columns with round or pin ends, and assume the columns to be so loaded that B is 10,000 lbs. per square inch. Then, by the formula (1),

$$\text{For } \frac{l}{r} = \quad 1, \quad 4, \quad 7, \quad 10,$$

Unit-stress C = 10,000.4 10,006.4 10,019.6 10.040.2 which are all practically in accord with the case of pure compression.

There is also no distinct line of demarcation between the case of a long column and that of the usual column of medium length. The proposed formula shows that Euler's formula is only strictly applicable when $l = \infty$, or when r is infinitely small with respect to l; yet for this case there is little practical difference between the two formulas when $\frac{l}{r}$ is greater than 300. For example, consider wrought iron columns with round or free ends, and suppose them to be so loaded that the unit-stress C at the middle of the concave side is 25,000 lbs. per sq. in., a little less probably than the elastic limit. Then the following is a comparison of the unit-loads, computed from the two expressions:

$$\text{For } \frac{l}{r} = 300, \quad 400, \quad 500, \quad 600.$$

By Euler,	B = 2,777	1,563	1,000	694
By (2),	B = 2,500	1,471	961	676

If, however, C be taken as 30,000 lbs. per sq. in., probably a little greater than the elastic limit, the last line has the values,

By (2),	B = 2,542	1,482	968	679

Which agree more closely with Euler, but a perfect accordance exists only at the limit when $l = \infty$

The following tables, which have been computed from formula (1), cover the principal part of the range of values most usual in structural designing, and will serve for approximate computations. If P be the load or total external stress of the column, and A the area of its cross section, then P divided by A is the unit-load B, and values of this in pounds per square inch are given in the first column of the tables. In the other columns are the values, also in pounds per square inch, of the maximum compressive unit-stress C on the concave side, corresponding to eight values of $l \div r$ ranging from 20 to 160.

I.—WROUGHT IRON COLUMNS WITH ROUND ENDS.

Unit-load. $\frac{P}{A}$ or B	Maximum compressive unit-stress C. $\frac{l}{r}=20$	$\frac{l}{r}=40$	$\frac{l}{r}=60$	$\frac{l}{r}=80$	$\frac{l}{r}=100$	$\frac{l}{r}=120$	$\frac{l}{r}=140$	$\frac{l}{r}=160$
5,000	5,040	5,170	5,390	5,730	6,250	6,980	8,220	10,250
6,000	6,055	6,240	6,560	7,090	7,890	9,080	11,330	15,560
7,000	7,080	7,330	7,780	8,530	9,720	11,610	15,510	24,720
8,000	8,100	8,420	9,040	10,060	11,660	14,646	21,460	.....
9,000	9,130	9,550	10,340	11,690	14,060	18,380	.....	.....
10,000	10,160	10,680	11,680	13,440	16,670	23,080	.....	.....
11,000	11,200	11,750	13,070	15,310	19,640	.....	.....	.....
12,000	12,240	13,000	14,500	17,320	23,080	.....	.....	.....
13,000	13,280	14,180	15,990	19,480	.....	.....	.....	.....

II.—WROUGHT IRON COLUMNS WITH FIXED ENDS.

Unit-load. $\frac{P}{A}$ or B	Maximum compressive unit-stress C. $\frac{l}{r}=20$	$\frac{l}{r}=40$	$\frac{l}{r}=60$	$\frac{l}{r}=80$	$\frac{l}{r}=100$	$\frac{l}{r}=120$	$\frac{l}{r}=140$	$\frac{l}{r}=160$
6,000	6,010	6,060	6,130	6,240	6,380	6,570	6,800	7,090
7,000	7,020	7,080	7,180	7,330	7,530	7,780	8,110	8,530
8,000	8,025	8,100	8,240	8,430	8,700	9,040	9,490	10,060
9,000	9,030	9,130	9,300	9,550	9,890	10,340	10,930	11,690
10,000	10,040	10,160	10,370	10,710	11,110	11,680	12,440	13,440
11,000	11,050	11,200	11,450	11,830	12,360	13,070	14,020	15,310
12,000	12,060	12,240	12,540	13,000	13,640	14,510	15,690	17,320
13,000	13,070	13,280	13,640	14,210	14,940	15,990	17,440	19,480
14,000	14,080	14,320	14,740	15,380	16,280	17,530	19,290	21,820

III.—STEEL COLUMNS WITH ROUND ENDS.

Unit-load. $\frac{P}{A}$ or B	Maximum compressive unit-stress C. $\frac{l}{r}=20$	$\frac{l}{r}=40$	$\frac{l}{r}=60$	$\frac{l}{r}=80$	$\frac{l}{r}=100$	$\frac{l}{r}=120$	$\frac{l}{r}=140$	$\frac{l}{r}=160$
6,000	6,050	6,200	6,470	6,880	7,500	8,430	9,870	12,300
7,000	7,070	7,270	7,650	8,230	9,130	10,540	12,900	17,400
8,000	8,090	8,380	8,770	9,650	10,870	12,990	16,760	24,590
9,000	9,110	9,450	10,000	11,140	12,850	15,850	20,930	.....
10,000	10,130	10,560	11,360	12,710	15,000	19,230	28,850	.....
11,000	11,160	11,690	12,670	14,370	17,370	23,300	.....	.....
12,000	12,200	12,820	14,020	16,130	20,000	28,300	.....	.....
13,000	13,330	13,970	15,400	18,000	22,940	.....	.....	.....
14,000	14,250	15,130	16,830	19,960	26,250	.....	.....	.....

IV.—STEEL COLUMNS WITH FIXED ENDS.

Unit-load. $\frac{P}{A}$ or B	Maximum compressive unit-stress C. $\frac{l}{r}=20$	$\frac{l}{r}=40$	$\frac{l}{r}=60$	$\frac{l}{r}=80$	$\frac{l}{r}=100$	$\frac{l}{r}=120$	$\frac{l}{r}=140$	$\frac{l}{r}=160$
7,000	7,020	7,070	7,150	7,270	7,430	7,650	7,900	8,230
8,000	8,020	8,090	8,200	8,380	8,570	8,770	9,200	9,650
9,000	9,030	9,110	9,250	9,450	9,730	10,080	10,550	11,140
10,000	10,030	10,130	10,310	10,560	10,910	11,360	11,810	12,710
11,000	11,040	11,160	11,380	11,690	12,110	12,670	13,410	14,370
12,000	12,050	12,200	12,450	12,820	13,330	14,020	14,930	16,130
13,000	13,060	13,250	13,530	13,970	14,580	15,400	16,500	17,990
14,000	14,070	14,250	14,610	15,130	15,850	16,830	18,150	19,960
15,000	15,080	15,310	15,710	16,310	17,140	18,290	19,870	22,060

Explanation of Diagrams.

Fig. 1 on the inset sheet is a graphical representation of the table for wrought iron columns with round ends, the unit-loads B being laid off horizontally as abscissas and the unit-stresses C as ordinates. The curved lines join the points for different values of the ratio $\frac{l}{r}$, and for each point on one of these lines the corresponding values of B and C can at once be read off. For example, if C = 20,000 lbs. per sq. in., and $\frac{l}{r} = 80$, then B = 13,300 lbs. per sq. in. Again, if C = 16,000 and B = 12,000, the corresponding value of $\frac{l}{r}$ is seen to be about 70. Or if the unit-load B is known to be 8,000 lbs. per sq. in. on a column where $\frac{l}{r} = 150$, then the maximum unit-stress C is seen to be 25,200 lbs. per sq. in., which is a near approach to the elastic limit of the material.

Fig. 2 gives a similar representation for wrought iron columns with fixed ends. Figs. 3 and 4 are for steel columns, the former for round and the latter for fixed ends. The limits of the diagrams for C extend to 35,000 lbs. per sq. in. for wrought iron and to 45,000 for steel, little higher, perhaps, than the elastic limits for ordinary bridge materials. By the help of these diagrams numerous problems in the investigation and design of columns can be rapidly solved with sufficient approximation, while the tables and formulas may be used for more accurate computations.

Investigation of a Column.

To investigate the security of a column of given dimensions under a given load, let A be the area of the cross-section and P the load. Then the mean unit load B is found by dividing P by A, or $B = P \div A$. The maximum compressive unit-stress on the concave side at the middle of the column is

$$C = \frac{B}{1 - \frac{n\,B}{\pi^2 E} \cdot \frac{l^2}{r^2}} \quad \cdot \quad \cdot \quad (1)$$

in which l is the length of the column, r the least radius of gyration of the cross-section, E the coefficient of elasticity, and n = 1, $\frac{4}{9}$, or ¼ — according to the arrangements of ends.

As an example, take a section for the upper chord of a bridge composed of two heavy Pencoyd 9-in. channels placed back to back, 6ins. apart, with a plate ½ -in. thick, 12 ins. wide, riveted on top. The material is steel, the length 18 ft., the ends on pins and the total compression or load is 168,000 lbs. It is required to find the maximum unit-stress C.

From the given data the area A is found to be 16.80 sq. ins., and the radius of gyration r = 3.01 ins. Then $B = P \div A = 10{,}000$ lbs. per sq. in., $l \div r = 71.8$, n = 1, and $\pi^2 E = 300{,}000{,}000$. Inserting all values in the formula there is found C = 12,070 lbs. per sq. in. Or, with sufficient accuracy, by interpolation in Table III., or Fig. 3, the value of C is found to be 12,150 lbs. per sq. in.

Safe Load for a Column.

To determine the safe load for a given column for a given unit-stress C, the formula is,

$$B = \frac{C}{1 + \frac{n\,C}{\pi^2 E} \cdot \frac{l^2}{r^2}} \qquad (2)$$

which gives the unit load B, and then the total load P is found by multiplying this by the area of the cross-section.

For an example, take the section where dimensions are given above, and let it be required to find the load P, which will cause a maximum stress C of 8,000 lbs. per sq. in. Inserting all values, or using the table, B is found to be 7,030 lbs. per sq. in., whence the load P is $7{,}030 \times 16.8 = 118{,}100$ lbs.

Design of a Column Section.

The design of the cross-section of a column to carry a given load with a maximum unit-stress C may be made by assuming dimensions, and then computing C by formula (1); if the agreement between the specified and computed values is not sufficiently close, new dimensions must be chosen and the computation be repeated. By the use of the tables above given, or by the help of the diagrams this will in general be the most advantageous method.

The formula may, however, be put into another form, which, in some cases, will abbreviate the numerical work. For B substitute its value $P \div A$, where P is the total load and A the area of the cross-section, and also write I for Ar^2, where I is the least moment of inertia of the cross-section. Then

$$I + \frac{P}{C} r^2 = \frac{n\,P\,l^2}{\pi^2 E} \qquad (3)$$

is a convenient expression, in which I and r^2 are the two quantities to be determined.

For example, let it be required to find the size of a square oak column with fixed ends when loaded with 24,000 lbs. and 16 ft. long, so that the maximum compressive stress C shall be 1,000 lbs. per sq. in. Here P = 24,000, C = 1,000, n = ¼, $\pi^2 = 10$, E = 1,500,000, $l = 16 \times 12$, and (3) becomes

$$I + 24\ r^2 = 147.5.$$

Now let x be the side of the square; then $I = \frac{x^4}{12}$ and $r^2 = \frac{x^2}{12}$, so that the equation reduces to

$$x^4 + 24\ x^2 = 1770,$$

from which x^2 is found to be 56 sq. ins., and the side x about 7.5 ins. Thus the unit-load B is about 430 lbs. per sq. in.

Conclusion.

The object of this paper has been to set forth the proposition that a rational formula for columns must, like that for beams, be deduced from the theory of stresses within the elastic limit, and to attempt to develop a formula on this basis which will enable the maximum internal unit-stress in a column to be computed. The results of the discussion are embraced in the proposed formula (1) and in the tables and diagrams for wrought iron and steel columns. The formula is not true when the elastic limit of the material has been exceeded, and, like the rational formula for beams, it cannot be verified by tests of columns to destruction. It is, however, believed to be very closely correct within that limit, and if it should not be thought wholly satisfactory from every theoretical point of view, it is hoped that it may prove a step towards the desired consummation.

A COMBINED CATCH BASIN AND MANHOLE FOR SEWERS.

We illustrate herewith a combined catch basin and sewer manhole designed by Mr. W. S. Shields, Consulting Engineer, of Chicago. As will be seen from the drawings, the catch basin and manhole are combined in a single construction located at the intersection of the center lines of the two streets, and the drainage water conducted to them by pipes running from small cast iron inlet basins at the street corners. There are at present 32 of these basins in use at Waukegan, Ill., which, it is stated, are giving entire satisfaction.

Fig. 1 shows a horizontal and vertical section of the combined manhole and catch basin at the cen-

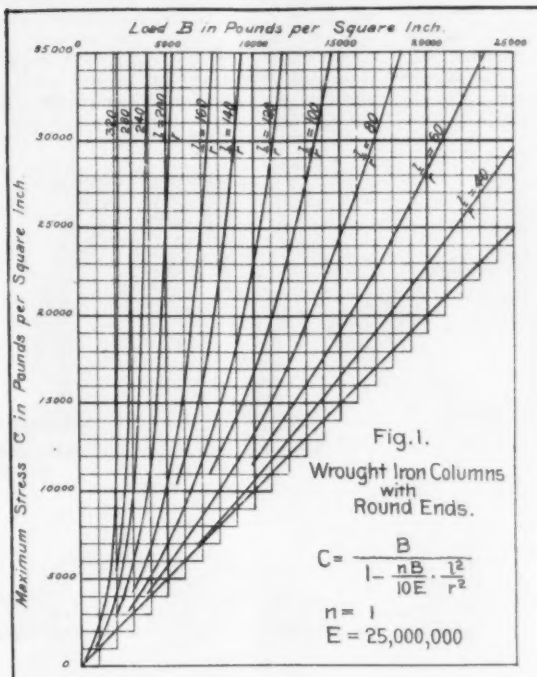


Fig. 1.
Wrought Iron Columns
with
Round Ends.

$$C = \frac{B}{1 - \frac{nB}{10E} \cdot \frac{l^2}{r^2}}$$

n = 1
E = 25,000,000

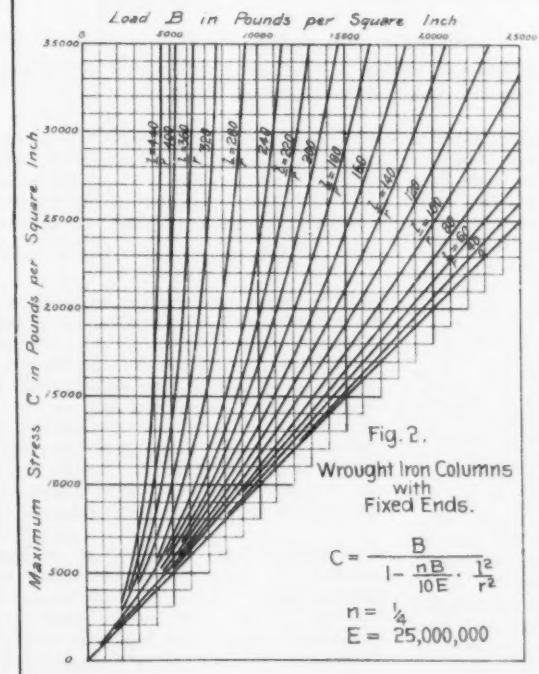


Fig. 2.
Wrought Iron Columns
with
Fixed Ends.

$$C = \frac{B}{1 - \frac{nB}{10E} \cdot \frac{l^2}{r^2}}$$

n = ¼
E = 25,000,000

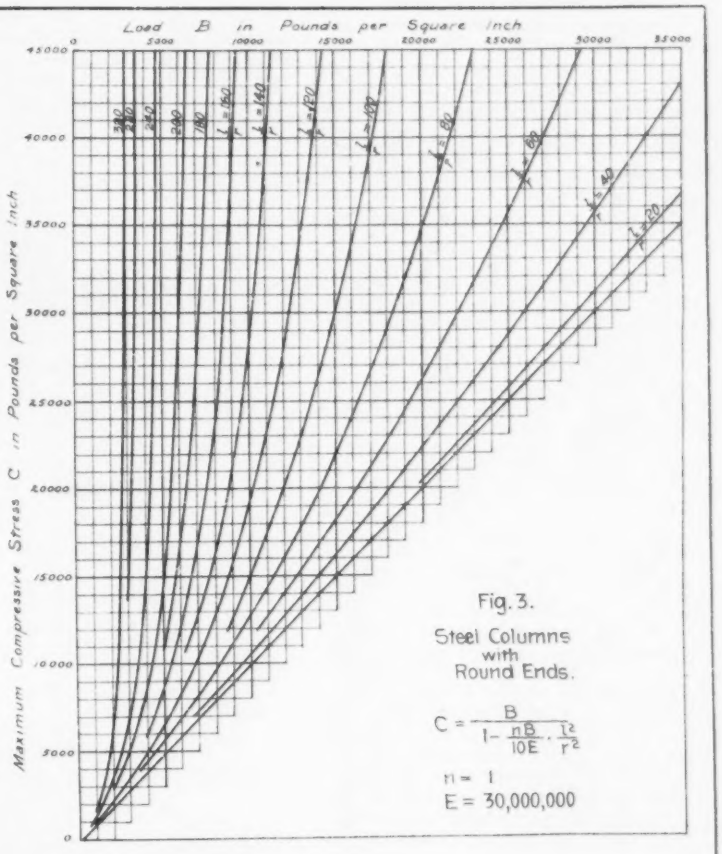


Fig. 3.
Steel Columns
with
Round Ends.

$$C = \frac{B}{1 - \frac{nB}{10E} \cdot \frac{l^2}{r^2}}$$

n = 1
E = 30,000,000

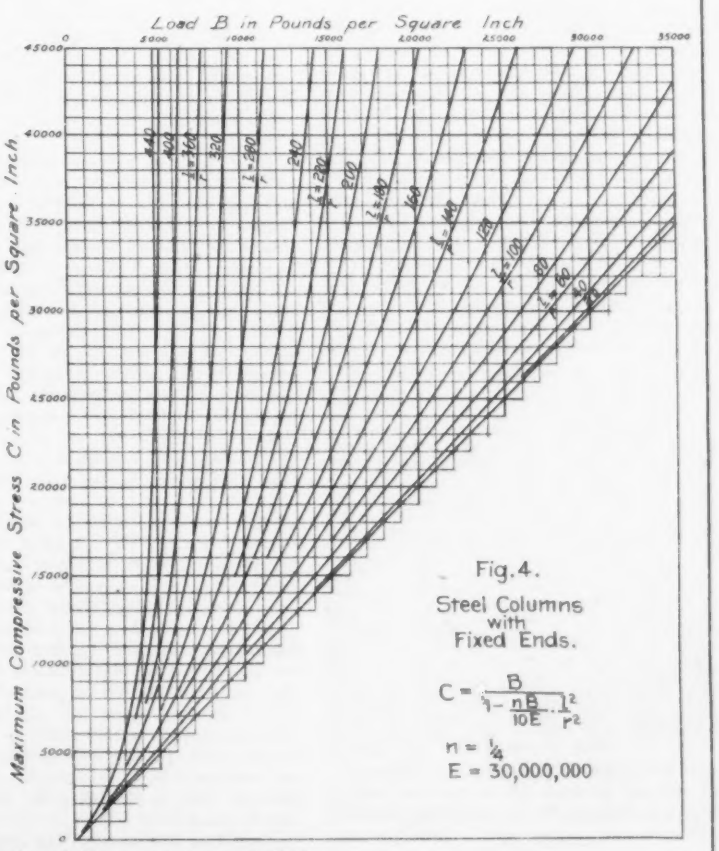


Fig. 4.
Steel Columns
with
Fixed Ends.

$$C = \frac{B}{1 - \frac{nB}{10E} \cdot \frac{l^2}{r^2}}$$

n = ¼
E = 30,000,000

P—Total Load on Column.

A—Area of Cross Section.

B—P ÷ A—Load per Square Unit of Area.

C—Maximum Compressive Unit-Stress on Concave Side at Middle of Column.

E—Coefficient of Elasticity of Material.

l—Length of Column.

r—Least Radius of Gyration of Cross Section.

n—1 for Round or Pin Ends, ½ for one End Round and the other Fixed, or ¼ for Fixed Ends.

Diagrams for the Rational Computation of Columns.

By Mansfield Merriman, M. Am. Soc. C. E.

CHAS. HART & SONS, LITH., 95 VESEY ST., N. Y.

ter of the street. The outlet pipe into the sewer is at a higher level than the inlet pipes into the catch basin, and affords an opening into the sewer for ventilation. A plan and section of the cast iron inlet are shown in Fig. 2. Ordinary vitrified sewer pipe is used to connect the inlets with the catch basin. This construction is claimed to cost 30% less than the usual form of four catch basins at the

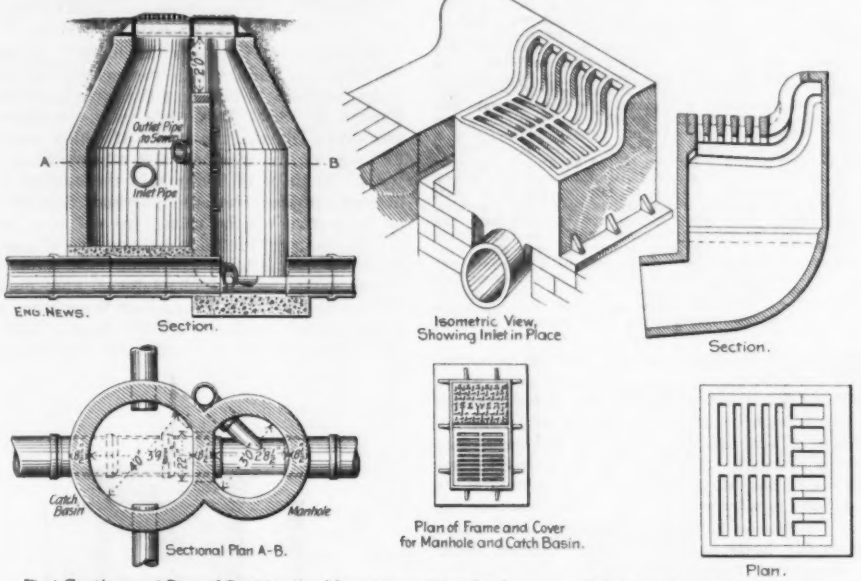


Fig. 1. Section and Plan of Combination Manhole and Catch Basin. Fig. 2. Details of Inlet.

COMBINATION MANHOLE AND CATCH BASIN, WAUKEGAN, ILL., SEWERAGE SYSTEM.
W. S. Shields, Chief Engineer, Chicago, Ill.

street corners and manhole at the center of the street. Another advantage claimed is that in case the width of the street is changed the position of the inlet basins can be changed at small cost without disturbing the masonry of the catch basin.

RUSTLESS COATINGS FOR IRON AND STEEL.

The inefficiency of the ordinary coating of paint in preventing the corrosion of iron and steel has led to the invention of various preservative processes and rust-protecting compounds for the treatment of these metals when used in structures exposed to the moisture and gases contained in the atmosphere. Several of these preservative processes are described and discussed in a paper read by Mr. Matthew P. Wood, of New York city, at the Montreal meeting of the American Society of Mechanical Engineers, from which we abstract the principal details.

Although the protection of small articles by a vegetable lacquer has been practical for centuries, it would appear that the use of rustless coatings for large articles of steel and cast and wrought iron has been developed only within a comparatively short time. The Bower-Barff process of coating cast and wrought iron and steel with a magnetic oxide was developed about 1875. This process consists in forming a protective coating for the metal at the expense of the metal itself, and is described as follows:

> The process, in brief, consists of placing the articles to be coated in a muffle, heated to approximately 1,000° F., and when they have attained this heat, either by extraneous firing of the muffle, or by passing producer gas or the products of combustion through the muffle and amidst the articles contained, or by both methods named, steam superheated to the temperature of 1,000° F. is then admitted to the muffle, and the formation of magnetic oxide begins at once. The heat of the muffle decomposes the steam, setting hydrogen free, which can be utilized to assist in maintaining the heat of the muffle; the oxygen uniting with the iron to form Fe_3O_4 or magnetic oxide. The period of exposure is from five to twenty hours, according to the size of the articles and depth of coating required, which varies from .01 to .1 in., and can be continued almost indefinitely, or until all moderate thicknesses of iron are resolved wholly into oxide. The color of the magnetic oxide so formed is a dull blue-black; the coating is tenacious, though when broken through by drilling, shearing, or mechanical injury, oxidation of the injured surface proceeds more rapidly than in untreated articles.*

The high heat and intermittent character of the Bower-Barff process are destructive to the retorts and muffles. Moreover, the process materially weakens the articles treated, not only by the amount of the material changed to the oxide, but also, particularly in wrought iron, by burning out the cinder in articles long exposed to the heat, making what forgers and rollers call "dry iron." A further objection occurs in structural work held together by rivets, where the heat causes the rivet to loosen. On the other hand, it is stated that the coefficients of elasticity of the oxide and the metal from which it is formed are so nearly the same, that articles so coated are not injured by compression, tension or vibratory stresses. When applied to ironwork, pipes, etc., exposed to acidulated waters in mines and other places, the coating has worked satisfactorily.

Information regarding the cost of the process is meager. Much, of course, depends upon the size of the articles, the depths of the coating, and whether the furnace or muffle is operated continuously or not. In any case, it must be an expensive process per pound or square foot, on account of the careful superintendence and skilled labor required, and the expense of superheating the steam to the necessary temperature of 1,000° F. Costs given range from $5 to $20 per ton of articles treated, but there are many situations in which the protection given by this process will bear an addition to these figures. The amount of steam required if used alone for the oxidizing element and for coatings of a moderate thickness, is determined to be for each pound avoirdupois gain in weight of iron oxidized to form the magnetic oxide 3 lbs. of steam, or 75 cu. ft., at or slightly above atmospheric pressure. This is the theoretical amount of steam needed to furnish the oxygen; in practice from 25 to 33% more is passed through the superheater and muffle to get results. The deeper the coating the more steam is required.

The Bower-Barff process has been superseded by more improved processes, one of which is in use at the National Armory, at Springfield, Mass., for treating gun barrels. The latter process is also used for treating numerous kinds of small articles, such as saddlery fittings and articles made of malleable iron, drop forgings, etc. The process consists in immersing the article in a bath of metal nitre, which contains a small percentage of peroxide of manganese, and is described as follows:

> A brick furnace is built around the nitre pot and a coal fire maintains the heat of the mixture, which has a temperature of about 650° F. The articles, polished but not burnished, or unduly raised in lustre, are simply immersed and moved about in the bath for a given time or until the requisite color is obtained, which can be ascertained by raising the articles out of the bath, and re-immersing them any number of times until the color is right; then they are removed, cooled in the open air to about the temperature of boiling water, then plunged into hot water to remove the nitre, and then into a sperm oil bath to complete the process. The nitre used must be refined, the commercial article not giving uniform results.

M. Bertrand, of France, has devised processes for coating iron with magnetic oxide and for enameling iron and iron carburets that are of interest as being possibly more simple and effective than the Bower-Barff process, and are evidently based upon a new discovery in chemistry which may be thus stated: If a thin adhesive film of another metal is formed on a steel, wrought or cast iron body, and this article be then heated to 1,000° F. and exposed to a current of oxidizing gas, the oxygen penetrates through the film, oxidizes the body metal, and forms magnetic oxide. The film of metal deposited in the first instance disappears in some obscure way, forming oxides which mingle with the magnetic oxide or volatilize according to the nature of the metal of which they are composed. M. Bertrand's experiments to find the best metal for depositing the primary coating led him to select bronze, which gave perfect satisfaction, and for depositing it upon the articles to be coated with oxide he uses electricity or wet baths, and sulphophenolic acid.

The following is the method adopted by M. Bertrand for oxidation:

> The article is cleansed and dipped a few moments in a bath containing a solution of sulphophenate of copper and tin. A slight coating of bronze is formed and the article is immediately washed in cold water and dried with sawdust, then placed in the furnace. Oxide forms, and at the end of 15 or 30 minutes, according to the size of the articles, it is sufficiently oxidized, the coating formed varying from 1-10 to 1-5 mm. for these exposures; longer periods give thicker coating to any desired extent.

For enameling iron by the Bertrand process the article is first coated with the magnetic oxide, as described above, then brushed over or dipped cold into the borosilicate of lead, colored with metallic oxides, to which is added a little pipe-clay to give the bath more body. The article thus covered is put into the furnace, the enamel adheres and vitrifies at the ordinary temperatures used by enamelers.

A process of forming a black or magnetic oxide that has a limited application is the Maritens patent process, in which the article to be oxidized is connected to the anode pole of a galvanic battery and immersed in hot water, when it becomes oxidized. A repetition of the process is necessary to secure a favorable result. In this process the water is decomposed by electrolysis, the hydrogen being set free, while the oxygen goes to the iron to form an oxide coating.

Another process for coating iron and steel at the expense of the metal itself is the Gesner Rust Proof Process, which, it is claimed, changes the surface of the metal into a compound of hydrogen, iron and carbon, which is designated as a double carbide of hydrogen and iron. The apparatus and process of treatment are described as followed:

> Two ordinary clay gas retorts of any required length, from 7 to 20 ft. or more, are set side by side with a furnace and grate below and between them, same as a gas retort setting. Suitable doors are fitted to one or both ends of the retorts as used for gas retort work. These retorts are heated to 1,000 or 1,200° F., as may be determined by the character of the articles to be treated. The articles are placed in the retorts, and exposed to the heat for 20 minutes or until they attain approximately the heat of the retort or muffle, when steam at low pressure is admitted to the inside of the retort through an iron pipe lying on the bottom of the retorts, and called a hydrogen generator, which decomposes the steam, hydrogen being set free, which fills the retorts, the surplus pressure passing out by a purge pipe sealed in about 1½ ins. of water to prevent ingress of air to the retorts. This steam treatment is kept up for 35 minutes, when a small quantity of naphtha—a pint or more—is injected by gravity into each retort, and allowed to flow for 10 minutes. The hydro-carbon is then cut off, and the steam, which has been allowed to flow during the whole operation is continued some 15 minutes longer. The whole time employed is therefore an hour and 20 minutes for articles of ordinary size and weight, such as builders' hardware, etc. (The process was described in Engineering News of March 31, 1888.)

Recently an electro-browning or electro-enamel process, known as the Haswell process, has come into use, which in cost of application and effectiveness appears to rank next to the nitre process before mentioned. This process consists of protecting the surface of iron and steel by a deposit mainly of peroxide of lead, prepared by the electrolysis of a suitable lead salt in cold water. The coating, while possessing considerable resisting power to the moisture, carbonic acid and ammonia that is normally in the air, and also to diluted mineral and organic acids and the chemical and other

*A full description of this process was given in Trans. Am. Soc. M. E., vol. IV., p. 351.

fumes of the workshop, is not, however, of so high resisting power as to withstand immersion in either water, sea-water, or acidulated mixtures beyond 48 hours, which, under these conditions, appears to be about the limit of its protective qualities. It can be polished on ordinary buffing wheels after it is applied. Whether dry or moistened it creates no changes on the surface of the article coated, and is not affected by mechanical injury like a blow, so as to flake off, expose the surface, and cause a rust spot to form. The cost of material in the electro-bath is 10 cts. per 100 sq. ft. of surface coated. The apparatus required consists of a few tanks to hold the lead solution, a few reels or racks to support the articles; the whole at a cost of from $25 to $250. An ordinary electroplating dynamo is required, the size depending upon the amount of work to be done, and power to drive the dynamo, etc., from 1½ to 2 volts is all that is necessary.

The several processes which have been described are applicable only to small articles or to separate members of structural iron or steel work before erection. Practically the only method of protecting large surfaces of iron and steel is by the application of some sort of paint or lotion, and here the nature of the paint and the method of applying it have much to do with its effectiveness. Some experiments made by the U. S. Navy Department on the preservation of ship plates from fouling show this very clearly. These are described as follows:

A plate of iron covered with asphalt paint was immersed in sea water for eight months and six days. At the end of that period it was found to be covered with scum and mud and very badly pitted. A plate coated with iron paint was found to be covered with shell and coral, but little paint remained and the plate was badly pitted and rusted. A plate with two coats of red lead was found to have a few barnacles attached, but to be in fair condition, with no rust whatever on the iron after the paint was removed. The red lead not only protected the iron better than the other pigments referred to, but the plates were in better condition as regards barnacles and fouling. The superiority of red lead being thus established, it is adopted for use on the hulls of all government vessels.

Graphite, mixed with pure boiled linseed oil, in which a small percentage of litharge, red lead, manganese or other metallic salt has been added at the time of boiling to aid in the oxidation of the oil, forms a most effective paint for metallic surfaces, as well as for wood and fibrous surfaces. Wood surfaces protected by this paint and exposed to the action of sea-water for a number of years are found in a perfect state of preservation. Some recent experiments with this paint applied to the surface of boiler flues show that it prevents the formation of scale to a wonderful degree, and though it would seem in this case to also prevent the transmission of the heat to the water, yet it appears to be a better conductor than the scale which it prevents from forming.

Coal-tar, a product from the distillation of gas coal, when properly prepared also forms an effective protection from corrosion of iron and steel from ordinary atmospheric attack, and if reduced to a pitch compound and applied to the metal in form of a hot bath, in which the article is immersed for a sufficient time to allow it to attain the same temperature as the bath, the coating formed is but slightly inferior to red oxide of lead paint, and in some applications is much cheaper.

Possibly the most extended application for a single purpose of the use of any process other than paint for the preservation of iron and steel from atmospheric corrosion has been made at Philadelphia, Pa., in the tower of the new City Hall. The process used here is a double one, and is described as follows:

The first process is designed to protect the iron from rust by an electro-plating of copper of 14 oz. per sq. ft. of surface, and a finishing coat of an alloy of aluminum and tin of 2½ oz. per sq. ft., for color to harmonize with the stonework of the lower stories of the tower; also to prevent oxidation of the copper into a green coating of verdigris.

The process was adopted as a substitute for paint, the periodical renewals of which would cost $10,000 per annum, the primary coat of which was to be boiling linseed oil, in which all material was to be immersed until they had attained the temperature of the bath. The total weight of wrought and cast iron to be protected is about 500 tons, and comprises 100,000 sq. ft. of surface, the largest single pieces being 16 columns 27 ft. long and 3 ft. in diameter, weighing 10,600 lbs. each. These columns received the copper coating inside as well as outside. The outside coating, being most exposed, is a double one, requiring two operations or baths, while the aluminum coat is given last as the protective coating to all beneath it. The cost of the whole process varies from 40 cts. per. sq. ft. to $1.00, depending upon the shape of the piece—simple plates, rods, angles, etc., coating the least, while curved pieces, with large lugs, flanges, with core holes, cost the most, the principal expense being the cleaning, the greatest care being necessary to insure good work.

The manipulation to apply the process necessarily varies with the shape and size of the piece. Suitable cranes, trolleys, hoisting gear, trucks, etc., being provided to handle one of the large columns referred to, the operation of coating it is as follows:

The column is first immersed in a tank containing a strong solution of caustic soda, heated by a steam coil, and is boiled a number of hours to remove all the grease and oil due to the machining process. It is then removed and thoroughly washed in water from a hose, then placed in a second tank and pickled with diluted sulphuric acid until all rust and scale are dissolved and loosened, then thoroughly cleaned with steel brushes and water and goes to the third tank containing the cyanide plating solution, and receives its first coating of copper. It is then removed from the bath and transferred to another tank and given a coating of paraffine wax inside, thence to the fourth tank containing an ordinary copper-plating solution, where it receives a heavy coating of copper, about 16 oz. to the sq. ft. of surface. The paraffine is then boiled off and the column enters the sixth or aluminum tank and receives a heavy deposit of aluminum, 2 to 3 oz. per sq. ft. It is then well washed with pure water and is ready for erection.

The columns and other pieces are brought into the electric circuit by wires passing around them like slings, and attached to a conducting brass bar over the tank. In the cyanide tank a current density of 3 amperes per sq. ft. is employed; in the acid tank, 10 amperes, and in the aluminum tank, 8 amperes. Separate dynamos for the several tanks are necessary, the developments being 1,000 amperes at six volts, 2,000 amperes at eight volts and 4,000 at two and a half volts.

The use of Japanese lacquer for the preservation of metallic surfaces, as well as those of wood, paper and other fibrous bodies, has never received the attention of engineers that the industrial importance of this method of coating and protecting surfaces demands. The general idea that its application is one of art, and is only adaptable to bric-a-brac, is wholly erroneous. The Japanese use it for an infinite variety of purposes—acid tanks, coating the keels of ships, highly finished coach and decorative panels and articles for domestic use, resisting hot water, soap and alkaline solutions. There is no reason why the lacquer tree should not thrive in this country. Its sap, which is used as the material for all lacquer work, is a natural essence, and vastly superior to any varnishes used here. Unlike even copal, which is an artificial mixture of resin, fatty oils and turpentine, Japanese lacquer is a ready-made product of nature that hardens into a mirror-like smoothness, never splits nor cracks and is of great durability.

At the Centennial Exhibition in 1876, in the Japanese department, there were exhibited plates, pans, etc., evidently of a common quality of lacquer used by sailors and others for domestic purposes; also some samples of a finer grade in trays and cabinet work that had been sunk in the sea over fifty years, and though covered with barnacles and other marine growths were practically unharmed, so perfectly had they been protected by the lacquer. It seems almost incredible that so valuable an article that can be produced as cheaply as maple sap has remained comparatively unknown in this country and Europe, at least so far as applying it to the palpable protective purpose for which nature evidently designed it.

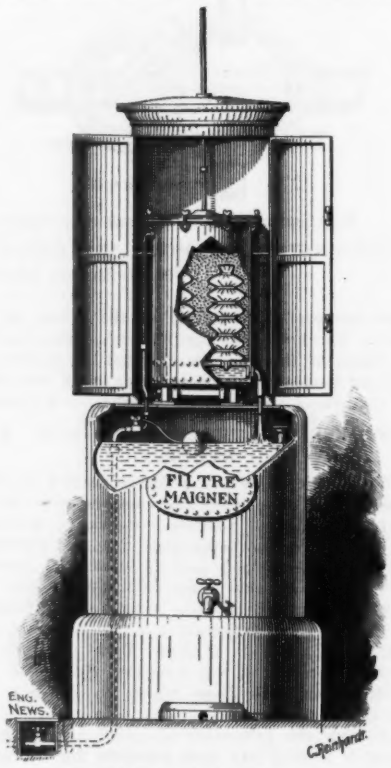
In conclusion, the whole question of how best to protect iron and steel from corrosion under all the varying conditions that the wants and usages of to-day demand is summed up by Mr. Wood as follows:

Don't use anything but common iron. Don't have any scale on that. Don't use anything but the best iron and steel. Don't polish those. Don't paint it with anything but pure linseed oil and oxide of lead or graphite paints. Don't let the air get to it if it is damp. Don't keep it from the air if the air is pure and dry. Don't let sea air, sea water, acidulated or sulphurous, ammonial or other fumes and liquids have access to it. Don't think it unnecessary to protect it in any case, because swords, armor and other bright articles of iron and steel have been found uninjured by rust after an exposure of over 500 years with no other protection than that afforded by the closed room in which they were placed. Don't think your own product would not under the same conditions last as long as the piece of iron that was walled into one of the burial chambers of the Pyramid 3,000 years ago. Don't put it into any location where it cannot be inspected and its true condition ascertained at any time, by anybody, your successor in the trust not excepted. Don't think that magnetic oxide, electroplating, enameling or any other method of protection will take the place of constant inspection, even if the coating is fired on by a Columbiad. Don't let the cost and interest accounts be the governing factors in the case of protecting any metal superstructure on whose continuity and strength human life and safety depend.

In this connection we may appropriately call attention to a new material for painting exposed metal surfaces, iron and steel roofs, iron bridges, etc., called by its manufacturers "anti-rust japan." The material is a black and strongly adhesive substance of about the consistency of printers' ink, and is applied with a brush like ordinary paint. Samples of metal coated with this substance show that the coating is very elastic, and does not crack off even by repeated bendings. It is claimed to be exceedingly durable in withstanding the action of the weather. The manufacturers of this "anti-rust japan" are Messrs. Allen, Ackley & Co., 171 Vine St., Cincinnati.

PUBLIC FOUNTAINS OF FILTERED WATER AT CHERBOURG, FRANCE.

An article in "La Revue Technique" of April 25 describes at some length the system of so-called filter fountains installed at the town of Cherbourg, France, in 1892. This town takes its water from the River Divette, the banks of which receive the drainage of the cesspools and other sewage of the town. In times of heavy rain the amount of filth drained into the river is so enormous that the course of its waters can be traced far out into the harbor by their color. As a consequence of using this river water, the town has often been subjected to severe epidemics of typhoid fever, and, finally, in February, 1892, the Minister of War, after an unusually severe epidemic of this disease, interdicted the further use of the water by the city. There



The Maignen Filter Fountain.

being no other available source of water supply sufficient for the needs of the town, the authorities were obliged to devise some method of purifying the river water, and after some investigation they decided to adopt the Maignen system of filter fountains, which had proven very successful during the cholera epidemic at Argentueil that same year. Ten of these fountains were first tried, and their success led to the extension of the system. Two forms are used, one a cylindrical fountain, as shown in the accompanying cut, and the other a cupboard like fountain set into the walls of buildings and projecting out slightly from them.

The general construction of the Maignen filter fountain is quite clearly shown by the illustration referred to. As will be seen, it consists of a reservoir for the storage of the filtered water surmounted by the filter chamber inclosed in a metal cylinder provided with doors. The filter chamber is carried on an axle, which permits it to be tipped down into a horizontal position so that the top can be removed and new filter material introduced. The water passes up through the pipe shown at the left into the top of the filter chamber, then down through the charcoal into the accordion-shaped sacks and thence into the reservoir. The cock

shown underground at the left serves to regulate the flow of the water, which is also completely stopped when the reservoir is full by a cock actuated by the float shown.

The accordion-shaped sacks, which are the peculiar feature of this filter, are made of amianthus cloth covered with a coating of impalpable charcoal powder. Amianthus is a fibrous mineral resembling asbestos and the filaments can be woven into a cloth of very fine texture by the aid of flax. The flax is afterward burned away, leaving the mineral fibers only. It is stated that this cloth as used for these filters is so closely woven that the passage of the water through it is due to capillary attraction. The sacks are embedded in powdered charcoal.

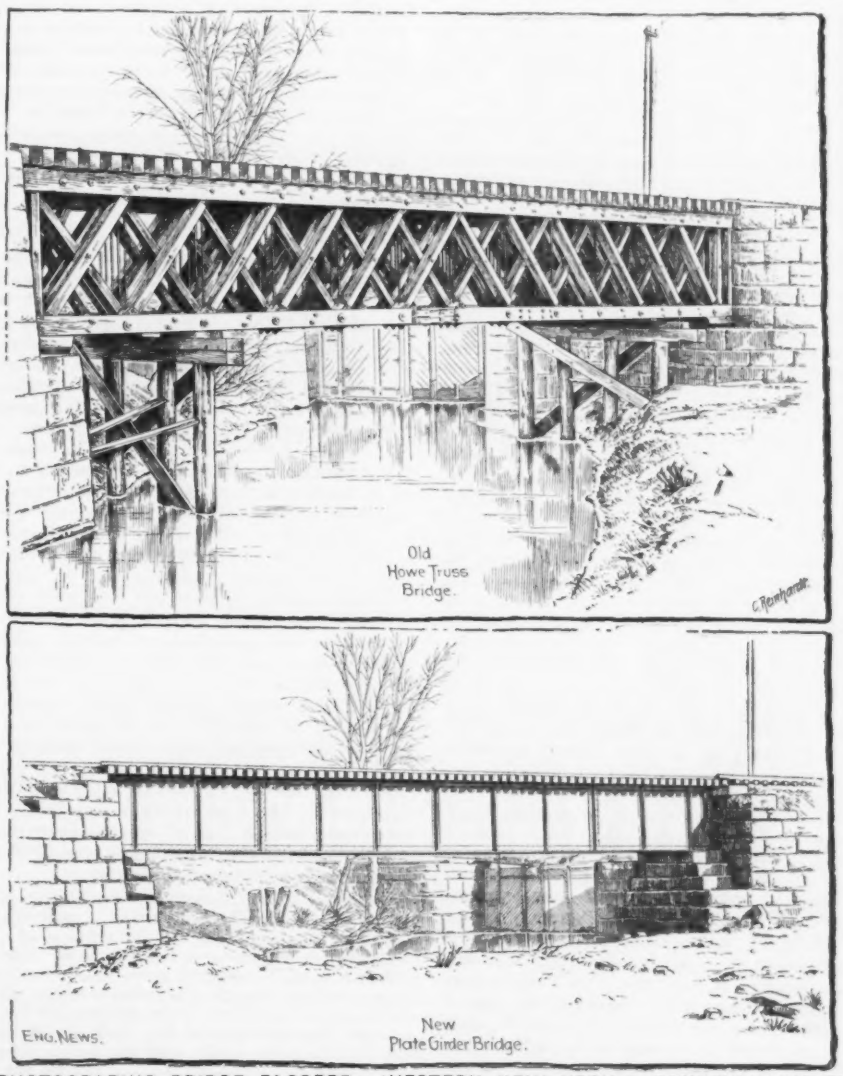
It is claimed that the water in going through these filters is thoroughly oxidized, destroying all organic matter, and that chemical and bacteriological analyses show that neither chemical salts nor micro-organisms will pass the filters.

NOTES BY RAIL.

Western New York & Pennsylvania Ry.—This railway, with an aggregate length of about 640 miles, has lines extending from Buffalo and Rochester, N. Y., through oil and lumber regions, manufacturing districts and summer resorts, connecting with Pittsburg by the Allegheny Valley Ry., and having other important railway connections. The track is laid with 67-lb. steel rails, and while Scotch rails of this weight lasted well for twelve years' service without battering of the ends, the newer American rails have been much less satisfactory. This has been the experience of several railways, and while no doubt due in part to the increased wheel loads and increased traffic, it is certain that the average steel rails to-day are of decidedly inferior quality to those made more carefully at a time when higher prices prevailed and more care was taken in the manufacture. There is no trouble in making good rails now if only the railways will insist upon getting them and will recognize the economy of a good price for a good article. The rails are 4½ ins. high and 4½ ins. width of base, with flaring sides to the head, 11-32 in. top corner radius and 11 ins. top radius. They are laid with broken suspended joints, spliced by 26-in. angle bars with four ¾-in. bolts spaced 6, 6¼ and 6 ins. c. to c. The bars weigh 42⅛ lbs. per pair, the bolts and nuts 87½ lbs. per 100, and the Goldie spikes 60 lbs. per 100. The bolts have square nuts ¾ × 1¼ ins. The ties are mainly of white oak, costing about 60 cts. each, and are spread only just far enough apart for shovel tamping, giving generally 16 ties to a rail, with the joint ties spaced 10 ins. between the edges of the top faces. The ballast is of coarse and rather dirty gravel, with a considerable admixture of large rounded pebbles. Bridge ties are 6 × 8 ins. section and 10 ft. long, spaced 4 ins. apart, and the bridge floors have outside wooden guard rails and inside iron guard rails, the latter being brought to a point on the approaches. One large iron bridge has a solid floor of built-up rectangular troughs, with ties 8 × 11 ins. and no ballast, as it is considered better to keep the ironwork free for inspection and painting. A number of wooden Howe truss bridges have been renewed after having been shored up by trestle bents, on account of the heavy engines now used, and much of the masonry has had to be renewed or refaced with Pennsylvania sandstone, the material originally used being a shaly rock, which disintegrated very badly under the effects of the weather. Riveted and pin-connected trusses are used, and also plate girders, one of the latter having wooden floor beams below the bottom chord, suspended by heavy rods passing through the beams and through the top chords of the girders. The accompanying cuts represent an old wooden Howe truss bridge and the new plate girder bridge which has replaced it, and shows also the gates of an old canal lock. The new girders are 67 ft. long, with a clear span of 65 ft. Photography is extensively used in the engineering department, and photographs are taken and blueprints made of old and new structures, masonry or other work that requires repairs, etc., the views materially assisting the engineer's report or call for repairs. Each division engineer is furnished with a camera.

The mile signs are boards nailed upon the telegraph poles. Whistle signs are white boards with a black band and a white W. Stub switches are used in sidetracks and yards, but split switches and spring rail frogs are used on the main track, many of the split switches having a single guard rail in front of the switch point. This road, like many others, is doing considerable work in replacing trestles by solid banks and masonry or pipe culverts. In order to facilitate the rapid and safe construction of temporary structures in case of accidents, washouts, etc., the maintenance of way department issues to bridge men, carpenters, etc., a table, giving the width of stringers of different depths for various spans, which table was published in our issue of July 5.

The passenger engines on this line are mainly of the ten-wheel type, but heavy consolidation engines are used in coal service, the maximum weight on driving wheels being 113,800 lbs. There are some Baldwin four-cylinder compound engines of the consolidation type, used mainly in coal service. The freight equipment includes a number of the Iron Car Co.'s tubular-frame flat cars, built by the Bloomsburg Car Co., of Bloomsburg, Pa.



PHOTOGRAPHIC BRIDGE RECORDS; WESTERN NEW YORK & PENNSYLVANIA RY.

At Machias the station is so placed that trains stop upon a track crossing, an arrangement which is unfortunately too common, and which may be easily altered so as to avoid the danger. The chances of collision are no doubt small, but there is no need of running such chances of incurring a serious accident. This crossing is at an angle of about 90° and is laid upon timbers placed at an angle of 45°, without plates under the crossing frogs, but with heavy guard rails bolted to the running rails and to outside angle knees. Mr. Robert Bell is General Superintendent and Mr. R. D. McCreary Chief Engineer.

Buffalo & Susquehanna Ry.—This railway (formerly the Sinnemahoning Valley Ry.) extends from Keating, on the Western New York & Pennsylvania Ry., eastward to Galeton, Pa., a distance of 49 miles. From the latter point an extension of 13 miles is being built to Ansonia, on the Fall Brook Ry., paralleling the Addison & Pennsylvania Ry. from Galeton to Gaines, a distance of about 6 miles. The line traverses a rich lumber district now being cut over. There are five or six switchbacks on the present line, and the maximum grades are 2½% in getting through the mountains by a steep and winding location. The track is of 60-lb. and 70-lb. steel rails, spliced generally with 24-in. four bolt angle bars, but in some places larger six-bolt angle bars are used. On the older rails the 24-in. bars have bolts spaced 5, 8 and 5 ins. c. to c., while the bolts of the heavier rails are spaced 6 ins. c. to c. There are plenty of ties, and the ties are of ample width. On heavy curves bridle rods are sometimes used, three rods being used to a rail length. The advantage of barking ties is shown in places where the track has shifted laterally, leaving the bark in its old position, the ballast holding the bark and the tie itself being thus free to slide in the smooth, loose bark. At Austin are a machine shop, roundhouse, etc., but new shops, roundhouse, turntable, etc., are to be built at Galeton by the Shiffler Bridge Co., of Pittsburg, Pa.

For the freight and lumber trains heavy consolidation engines are used, while the passenger trains are hauled by powerful and handsome ten-wheel engines, built by the Baldwin Locomotive Works. For the logging trains, which carry the logs cut in the woods and piled alongside the track, there are several of the Shay geared locomotives (Eng. News, April 26, 1890), built by the Lima Machine Works, Lima, Ohio. There are three vertical inverted cylinders at one side of the engine, driving a horizontal shaft with bevel gears meshing with bevel wheels

bolted to the faces of the driving wheels. All the carrying wheels are utilized for traction, universal joint couplings connecting the shafts between the trucks. Some of these engines have a four-wheel truck under the boiler and two under the tender, while others have the trailing truck under a rear bunker. One engine, with a short tender, has a middle truck between the engine and tender, where it gets little adhesive weight. These engines have steam brakes, a long horizontal steam cylinder operating the brake rod, and there is a tread and flange-bearing brakeshoe to each wheel. The spreading of grease from the gearing to the rim of the wheel would seem to cause danger from the wheels slipping on the greasy brakeshoes or rails. The engines work very well, however, and can take sharp, rough curves easily. The sound of the "three-legged" exhaust is very singular.

At Galeton the new line crosses the river and follows the bank for several miles. The work is comparatively light, the maximum grade being 0.7 to 0.8%. A large part between Galeton and Gaines is sidehill cutting, partly rock and partly earth. Work is being hurried along on the uncompleted parts of the grade, as grading is to be completed by Aug. 1. In some of the rock cuts heavy charges of high-power dynamite are used, about 15 holes being fired at once, the effect being to lift the rock and roll it over, shattering it into small pieces so that it is easily handled by shoveling. The work is let in two contracts to Franklin and Grego. The Chief Engineer is Mr. Herdon and Mr. C. W. Goodyear is the Vice-President and General Manager.

Lehigh Valley R. R.—This road has a double track all the way from New York to Buffalo, 458 miles, and the main tracks are laid with 80-lb. rails, spliced by heavy 30-in. angle bars of the Sayre pattern, with six bolts spaced 5, 4, 4, 4 and 5 ins. c. to c. The bolts have button heads outside the rail and hexagon nuts and spring nutlocks inside. The rail ends are cut at an angle of 45°, this being about the only road which follows this practice to any extent, and while the track rides easily and the rail ends show an even wear, these results are almost certainly due to the stiff and heavy joint fastenings, rather than to the angle-cutting of the rail ends. The rails are laid with broken, suspended joints, and there are 16 ties to a rail length of 30 ft. The joint spacing of the rail ends is irregular, and during the hot weather of June, while many of the joints were quite closed, others had a space of ½ to ⅝ in., measured on the square. Some of the old Sayre splice bars with four bolts have a rib on the top of the outer bar, which lies against the side of the rail head. On the new Buffalo extension, described in our issue of June 21, metal-surface cattle-guards are used, some of the Kalamazoo type, consisting of a steel plate with longitudinal ridges pressed up in it, and having sharp barbs between the ridges; and others consisting of a species of mattress of woven wire, an arrangement which seems open to the objection of getting animals caught by the hoofs and held so that they cannot get off the track. A very simple and neat design of whistle and ring signs is used, consisting of a diamond-shaped piece of sheet iron with a rod riveted to the lower corner, which rod is driven into a wooden plug in the iron pipe which forms the post. The pipe and target are painted black, with a white R or W. It is unfortunate that slag ballast has not been used on the entire length of this division, as the cloud of dust from the dirty gravel in dry weather is very annoying. The difference between this ballast and the clean slag ballast or the well-compacted cinder ballasts on the mountain division is very marked. Passenger trains are run as double-headers over the mountain division, generally with one eight-wheel and one ten-wheel engine, or with two ten-wheel engines. The same enginemen run continually on this division, and thus become very expert in handling the trains so as to maintain a uniform speed and so ensure steady riding of the cars. A somewhat novel arrangement for supplying refreshments during the journey is a "lunch car," which is attached to certain trains, and is fitted with a lunch counter, at which the ordinary light refreshments are served at card rates. In many cases such a car is more convenient for the passengers than a dining car would be, with its uniform charge of 75 cts. or $1 per meal. For milk trains long cars like baggage cars are used, but having turtle-back instead of monitor roofs. Mr. Charles Webster is Chief Engineer, and Mr. Rollin H. Wilbur is General Superintendent.

Buffalo Electric Railway Co.—This company operates about 125 miles of track, of which 103 miles are on the electric system, with overhead wires supported by posts placed on the curb lines in the business streets and in the middle of the suburban streets. Most of the cars are of the ordinary four-wheel pattern, and lurch very badly when running at high speeds, but on two or more of the longer routes there are large eight-wheel cars and these run much more steadily. These long cars have vestibuled or enclosed platforms and are fitted with the Genett air-brake. They seat about 16 persons on each side. The track in many places is decidedly rough, with uneven joints, and the shocks on entering the curves are very violent, the car being viciously "yanked" round in a manner most unpleasant to the passengers. Uncivil conductors appear to be somewhat numerous, and the way in which they adjure passengers to hurry on or off (especially when passengers have been carried past their destinations, owing to the incomprehensible jargon in which the names of streets are announced) is somewhat after the style of a Tammany heeler. On one line rails carried in chairs are being replaced with deep girder rails, resting directly upon the ties and joined by splice bars having two rows of holes.

THE FASTEST STEAMER IN THE WORLD.

The fastest vessel afloat is said to be the new twin-screw torpedo-boat destroyer "Daring," designed, built and engined by Thornycroft & Co. for the British navy, as during a recent trip on the Thames the vessel attained the unprecedented speed of 29 knots against the tide, though the current was slight. The following particulars are taken from articles in our English contemporaries, "The Engineer" and "Engineering." The "Daring" is one of five vessels of the same type now being built by the same firm, and is 185 ft. long, 19 ft. beam and 13 ft. deep, with 7 ft. freeboard. The deck is flush, with a turtle back over the bow in front of the conning tower and a breastwork at the break of the turtleback to throw back the water when steaming head to sea. At the stern the bottom slopes upward and is slightly concave in transverse section, forming a flat overhanging stern. The two propellers are carried under the arched bottom and there are two suspended rudders, placed on the same transverse line as the screws. The battery consists of one 12-pdr. rapid-fire gun on the conning tower, five 6-pdr. rapid-fire guns on the broadside and another mounted on a special carriage aft. There is a torpedo-discharger tube in the bow and two are mounted on carriages on the deck. These are for 18-in. torpedoes. With 73 persons and 19 tons of coal on board at the time of the trials the displacement was 228.6 tons. The engines are described as follows:

The engines of the "Daring" and her sister vessel, the "Decoy," now also finished, are of a new type designed by Messrs. Thornycroft for these vessels, and the first-class torpedo-boats just completed. They are of the three-stage compound type, and have cylinders 19 ins. diameter for the high-pressure engine, 27 ins. for intermediate, and two 27 ins. diameter for the low-pressure. The stroke is 16 ins. Each set of engines may be said to be divided into two parts. Thus the high-pressure and intermediate cylinders form one half, while the two low-pressure cylinders form another. The cylinders are inclined from the vertical alternately to the right and left. Piston valves are not used, but the larger surfaces of the flat side valves are balanced to relieve the pressure on the back. Following the line of the engines, we have first the eccentrics and link motion which work the slide valve of the high-pressure cylinder, which are run on an overhung part of the shaft. There is next a main bearing, after which come the high-pressure and intermediate cranks. Immediately aft again is another main bearing, and then the eccentrics for the intermediate slide valve, which are followed by the forward low-pressure eccentrics. Another main bearing follows, and then the two low-pressure cranks, after which another main bearing, and then the after low-pressure eccentrics, beyond which is the thrust block. The inclined position of the cylinders enables the axes of the cylinders to be brought close together in a fore-and-aft direction, and advantage is taken of this to introduce an arrangement of cranks that is certainly unusual for torpedo-boat practice. In place of there being a separate two-web crank for each cylinder with a length of shaft between, there are three webs to the two crankpins, the center web being common to both and receiving a crankpin at each end. The center web has naturally to be twice as long, or nearly twice as long, as each of the others—the cranks being almost opposite to each other—and it may be said, therefore, that the cranks are double-webbed. It will be seen that by this arrangement there is a considerable gain in fore-and-aft space occupied, no inconsiderable advantage in craft of the torpedo-boat type, where machinery occupies all the best part of the boat.

The main standards are placed close to the fore-and-aft center line of the cylinders, and are stiffened by inclined struts and there is no bedplate. By a system of balancing, vibration has been reduced to a minimum. The bow wave and wake disturbance are very slight.

The three Thornycroft boilers have a total heating surface of about 8,000 sq. ft., and the grate surface is 189 sq. ft. They are placed in two stoke-holds, the forward one having two boilers and the after one a single boiler. These boilers can raise steam from cold water in 15 minutes. The whole of the feeding is done by one Weir pump placed in the engine-room, there being, however, additional pumps to be used in case of accident. In order to solve the difficult problem of feeding a group of water-tube boilers from one pump, the builders have devised an automatic feed control. The blades of the propellers, three to each screw, are of phosphor bronze, keyed into a boss in a novel manner; it having been found that phosphor bronze requires somewhat different treatment to steel. Forced draft is supplied by fans, and at high pressure the flames stream from the smoke stacks.

In the trials the first run was made with the engines making 91 revolutions per minute, at which rate of steaming the observed speed was 7.86 knots. The engines were then opened out until they were running at 175 revolutions, when the speed was 14.2 knots. At 238 revolutions the speed was 18.3 knots. After this the revolutions were raised to 322 per minute, with which a speed of 23.4 knots was attained. Three runs were made at each of the stated revolutions. In the first of the final runs the pressure was 200 lbs., the mean revolutions were 382.9 per minute, and the speed was 28.214 knots. The boat was turned and the second run was entered upon, the steam being again 200 lbs., the revolutions averaging 385.7 per minute, and the speed being 28.571 knots. The vessel was once more turned and the third run was entered upon with the safety valves from both boiler-rooms blowing. The revolutions were 395.1 per minute, and the steam pressure 215 lbs. The speed reached the hitherto unequalled rate of 29.268 knots. This run was made against tide, doubtless a slack one, but certainly there was some current meeting the boat. The mean of the three runs gives a speed of 28.656 knots, and 384.3 revolutions. The guaranteed speed of the boat was 27 knots.

GOVERNOR FLOWER'S ORDER FOR SEWAGE PURIFICATION WORKS FOR FLATBUSH, N. Y.

Governor Flower, of New York, has taken a hand in an attempt to improve the sanitary condition of the village of Flatbush, in the town of Flatlands, on Long Island. It appears that Mill Creek has been grossly polluted by sewage, including gas house refuse, and that a leaky wooden sewer is in use. The Governor has ordered the bed of the creek cleaned, the leaky sewer made tight and the preparation of plans for the proper treatment of the sewage, the plans to be approved by the State Board of Health. Such action on the part of the governor of a state is a novelty, and the order in full is given below as likely to be of interest to engineers and others:

I, Roswell P. Flower, Governor of the State of New York, in pursuance of the statute in such case made and provided, do hereby declare the manner of the discharge of the sewage of the village of Flatbush into the stream known as Mill Creek, in the town of Flatlands, maintained by the Street and Sewer Commissioners of the town of Flatlands, to be a public nuisance, and I do order and direct that the manner of discharging the said sewage be changed in the following particulars, to wit:

That the sewer be thoroughly cleaned and freed from all gas-house sludge and other injurious deposits which may have deposited therein, and that so much of Mill Creek as has now deposited on the bottom thereof from said sewer, gas-house sludge and other injurious deposits, be cleaned.

That the wooden conduit of the sewer, which now leaks, be repaired and made tight.

That the plans be prepared for the proper treatment of the sewage before it is discharged into Mill Creek, and that said plans be submitted to and receive the approval of the State Board of Health, before the construction thereof.

That no sewage coming from the said town of Flatbush be discharged into Mill Creek in such a condition or in such a manner as will create a nuisance.

That in case other outlet sewers for the said town of Flatbush are hereafter constructed to discharge in waters where similar conditions exist as are found to exist in Mill Creek, the street and sewer commissioners in the said town of Flatbush are required to provide some method for the treatment of the sewage, the plans for which shall be sumbitted to, and receive the approval of, the State Board of Health before construction thereof.

In the default of compliance with this order by the persons hereinbefore mentioned, such further order may issue, upon the application of the State Board of Health, as may be necessary to secure the removal of the nuisances complained of.

PERSONALS.

Mr. C. M. Ward, General Manager of the South Carolina & Georgia Ry., has resigned that position, which he had held since 1889.

Mr. L. M. Martin has been appointed General Manager of the Iowa Central Ry., vice Mr. Edwin McNeill, Receiver of the Oregon Railway & Navigation Co.

Mr. William T. Small, Superintendent of Motive Power, of the Buffalo, Rochester & Pittsburg Ry., died at Rochester, N. Y., July 6. He was formerly Superintendent of Motive Power of the Northern Pacific R. R.

Mr. George Preston, formerly Superintendent of Motive Power, of the Canadian Pacific Ry., at Toronto Junction, Ont., has been transferred to the Eastern Division, and will be succeeded by Mr. George MacKinnon.

Mr. W. H. Kennedy, of Portland, Ore., has been appointed Chief Engineer of the Oregon Railway & Navigation Co.'s lines, which are now being operated independent of the Union Pacific Ry. by Mr. Edwin McNeill, as receiver.

Mr. W. S. Jones, Superintendent of the Manhattan Beach Division of the Long Island R. R., has resigned the position, to accept that of General Superintendent of the South Carolina & Georgia R. R., with headquarters at Charleston, S. C.

Mr. O. G. Hellman, Jr., M. Am. Soc. M. E., Instructor in the Department of Experimental Engineering at Sibley College, Cornell University, died at Williamsport, Pa., July 17. He graduated from Sibley College in 1891 and has since been engaged as instructor.

Gen. D. H. Bruce, Superintendent of the Water Department, of Syracuse, N. Y., has resigned, and Mr. W. R. Hill, Chief Engineer, will assume the duties of Superintendent. General Bruce has continued in his capacity as superintendent until the completion of the work of construction, when Chief Engineer Hill could attend to the duties of the office.

Mr. Dion Martinez, of Pittsburg, Pa., has returned from an extended trip to the United States of Colombia, during which he obtained from the government several important mining concessions for a Pittsburg syndicate. Work on the properties covered will be commenced this autumn. The concessions are in a new and little explored region of Colombia, and are said to promise to open up a rich gold region.

Mr. H. E. Folsom, Superintendent of the Passumpsic Division of the Boston & Maine R. R., has also been appointed Superintendent of the Connecticut River Division of that road, vice Mr. H. E. Howard. His headquarters remain at Lyndonville, Vt. Mr. Henry F. Sampson has been appointed Assistant Superintendent of the Connecticut River and Passumpsic divisions, with headquarters at Springfield, Mass.

Mr. Charles Henry Tompkins, Jr., of 15 Cortlandt St., New York, and Mr. Andrew J. Wiley, of Boise City, Idaho, have formed a partnership under the name of Tompkins & Wiley, to do a general engineering business, making a specialty of hydraulic work and irrigation. Mr. Tompkins was formerly the Chief Engineer of the Idaho Mining & Irrigation Co., and Mr. Wiley is Chief Engineer for the Owyhee Land & Water Co., now building canals from the Bruneau River, Idaho.

Mr. J. Herbert Bramwell, M. Am. Inst. M. E., who died in Paris on July 13, was a prominent mining engineer. He was born in Liverpool, England, Nov. 26, 1846, and came to this country at an early age with his parents. In 1871 he became the mining engineer and chemist of the Dunbar Iron Works in Pennsylvania. He was frequently employed at various furnaces and iron works in the South. He built the Quinnemont Iron Works in Virginia, and from there went to Ironton, O., as Vice-President and Manager of the New York & Ohio Iron & Steel Co. Foreseeing a great future in the Virginia coal region he turned his attention to coal mining and was the pioneer in developing the now famous coal fields of Southwest Virginia. The mining town of Bramwell, on the Norfolk & Western R. R., Pocahontas extension, was named after him.

Dr. George H. Williams, M. Inst. M. E., Professor of Inorganic Chemistry, at Johns Hopkins University, Baltimore, Md., died at Utica, N. Y., July 12, at the age of 38. He wast born at Utica, N. Y., and graduated from Amherst College in 1878. He founded the department of mineralogy and geology at the University in 1883, and had written a number of special reports for the U. S. Geological Survey. His writings include nearly a hundred geological and mineralogical papers in scientific journals, more than one-half of which treat of the geology of Maryland, especially in the vicinity of Baltimore. He wrote a book on "The Elements of Crystallography," and had been engaged for a number of years in preparing a new geological map of Maryland for the United States Geological Survey. He was one of the hundred members of the National Academy of Sciences, a vice-president of the Geological Society of America, and a member of the American Institute of Mining Engineers, the Washington Geological Society and other scientific bodies.

NEW PUBLICATIONS.

ELECTRICITY ONE HUNDRED YEARS AGO AND TO-DAY. By Edwin J. Houston, Ph.D. New York: The W. J. Johnston Co.; 12mo, cloth; illustrated; pp. 199; $1.

This is a reprint of a lecture delivered by Professor Houston before the Brooklyn Institute of Arts and Sciences, with a considerable amount of supplementary matter in the form of footnotes. It is, as its title indicates, an endeavor to trace briefly the history of electrical science from its birth to the present day. One of the most interesting and valuable features of the book is the elaborate system of footnotes which, in many cases, quote the exact words in which various discoveries were originally made known.

THE ANIMAL AS A MACHINE AND A PRIME MOTOR, AND THE LAWS OF ENERGETICS. By R. H. Thurston, Director of Sibley College, Cornell University. New York: John Wiley & Sons; 12mo, cloth; illustrated; pp. 97; $1.

In this little treatise the attempt has been made to gather all the available information regarding the animal as a prime motor into a book to interest the non-professional reader, and to serve as a book of reference for engineers. The book opens with an introductory chapter discussing the laws of energetics and of power-production and utilization. This is followed by the discussion of the main theme of the book, viz., the animal as a machine and prime motor. In this the author treats of the animal structure as a piece of mechanism, its sources of energy, the methods of the transfer and transformation of that energy from its original sources and the wastes which occur in these processes. Tables are given showing the work done by animals, their best rates, the effect of the variation of speed upon their working power, and the influence of the various favorable and unfavorable conditions upon their performance. The best dietaries and the relative values and energy contents of various kinds of foods are also discussed. The book closes with a discussion of some of the unsolved problems of the animal machine.

PRACTICAL INSTRUCTIONS IN QUANTITATIVE ASSAYING WITH THE BLOWPIPE. By E. L. Fletcher, U. S. A. New York: John Wiley & Sons, 12mo, cloth; 10 illustrations: pp. 142.

The writer of this book has aimed to present a cheap and simple practical manual on blowpipe assaying suitable for the use of the prospector, miner and assayer and persons not skilled in the more intricate methods of assaying minerals. Much that is contained in the ordinary treatise on blowpipe analysis has of necessity been omitted, and the aim has been to simplify and abbreviate the more important operations for making assays. The book is divided into seven chapters with an appendix. The first chapter is devoted to a description of the necessary apparatus and supplies for conducting blowpipe tests, and this is followed by chapters on reagents, flame colorations, soda reduction and qualitative tests. In chapter VII., the quantitative assaying of gold, lead, copper, tin, mercury, nickel and bismuth is described very concisely. The book closes with a table giving the costs of the various materials and apparatus necessary to the assayers' outfit, from which it may be noted that the cost of the apparatus required to perform the various operations described in the book is only $38.86.

SEWER ASSESSMENT: Report of the Sewerage Commissioners Upon a Sewer Tax for the City of Brockton, Transmitting the Report of the City Engineer Upon the Subject of Sewer Assessments. F. Herbert Snow, City Engineer. 8vo: paper; pp. 96, and table on folding sheet.

All but six of the 96 pages of this report are taken up with an elaborate study, by Mr. Snow, of the question of sewer assessments which we believe to be by far the most exhaustive presentation of the subject ever made. Mr. Snow first discusses sewer taxes in a general way and then takes up old methods of assessment, applying various plans to specific cases, such as the frontage and area plans, the two combined, the entrance fee method and the raising of the cost of sewers by general taxation. The yearly rental plan is next taken up, and finally the plan since adopted by the city of Brockton is described and discussed. This latter plan is given at length elsewhere in this issue. An appendix gives and summarizes the replies received from 82 cities in answer to letters asking for information regarding the methods in vogue to raise money to meet the cost of sewerage systems. A wide divergence of practice is shown as to details, but nearly all the cities raise a portion of the cost of the sewers by general taxation and the remainder by assessments on the property benefited, the proportions varying between wide extremes.

A LABORATORY MANUAL OF PHYSICS AND APPLIED ELECTRICITY. Vol. I. Junior Course in General Physics. By Ernest Merritt and Frederick J. Rogers. Edited by Edward L. Nichols, Professor of Physics Cornell University. New York: Macmillan & Co.; 8vo, cloth; illustrated; pp. 294; $3.

This is the first volume of a two-volume manual of physics and electricity for laboratory students, which the instructors in these branches of science at Cornell University have developed from their lectures and written directions to the laboratory students of that institution. As indicated, the book is simply a directing and explanatory manual to be used in conducting laboratory experiments in physics and electricity, the student being assumed to be familiar with the general theories and principles upon which these experiments are based. In general, in the first part of the work, explicit directions are given for conducting such experiments with different styles of apparatus, as, for instance, the determination of the laws of gravity is explained by Atwood's machine, from the motion of a freely falling body, by the physical pendulum, and by Kater's pendulum. As the work advances these directions are given less in detail and the student is thrown more and more on his own resources, until finally they consist merely of hints for advanced work. The book is quite fully illustrated with views of apparatus and explanatory diagrams.

TRADE PUBLICATIONS.

BOLTS, NUTS AND WASHERS. J. H. Sternberg & Son, Reading, Pa. 8vo; pamph.; pp. 51.

This is a very complete catalogue and price list of the various forms of bolts, nuts, rivets, lag screws, turnbuckles, etc., manufactured by the above named firm. A feature of general interest is the collection of tables showing United States standard screw threads and nuts, the manufacturers' standard bolt heads, weights of different sizes of screws, bolts and nuts per 100, and weights of different widths of strap iron per lineal foot.

EARTHENWARE HOUSES. Charles C. Gilman, Patentee, Eldora, Ia. Terra Cotta Lumber, Fibrous Brickware and Earthenware Houses. 4to; illustrated pamph.; pp. 24.

This pamphlet is devoted to a description of the application of terra cotta to fireproof construction and especially to the construction of small cottages for seaside and mountain resorts.

SOCIETY PROCEEDINGS.

CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.—The midsummer meeting will be held at Waterbury some time after the middle of August. It seems best to Mr. Cairns, the City Engineer of Waterbury, and to the members of the Executive Committee, to fix the date of this meeting later than usual, in order that the work on the new dam and reservoir may be at the most interesting stage of its progress when the members see it.

E. P. Augur, president; A. R. Wadsworth, secretary.

COMING TECHNICAL MEETINGS.

DENVER SOCIETY OF CIVIL ENGINEERS.
July 24. Secy., F. E. King, Jacobson Block.

WESTERN SOCIETY OF ENGINEERS.
Aug. 1. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 3. Secy., O. Von Geldern, 719 Market St., San Francisco.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 9. Secy., G. W. Shaw, Norton Building.

NORTHWEST RAILWAY CLUB.
Aug. 14. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Aug 14. Secy., D. W. McMorris, Burke Blk., Seattle, Wash

AMERICAN ASSOC. FOR THE ADVANCEMENT OF SCIENCE.
Aug. 16 to 23. Brooklyn, N. Y. Secy., W. Putnam, Boston.

AMERICAN FORESTRY ASSOCIATION.
Aug. 20 to 24. Brooklyn, N. Y. Secy., J. D. W. French, Boston, Mass.

SOCIETY PROMOTION OF ENGINEERING EDUCATION.
Aug. 20 to 23. Brooklyn, N. Y. Secy., Prof. J. B. Johnson, St. Louis, Mo.

ROADMASTERS' ASSOCIATION OF AMERICA.
Sept. 12. New York. Secy., W. W. Sharpe, Waycross, Ga.

ASSOC. SUPERINTENDENTS OF BRIDGES & BUILDINGS.
October. Kansas City, Mo. Secy., S. F. Patterson, Concord, N. H.

AMERICAN SOCIETY OF RAILWAY SUPERINTENDENTS.
Oct. 20. New York. Secy., G. A. Hammond, Boston.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

In our description of the new steel buildings which are being erected for the Pittsburg Reduction Co. at Niagara Falls, N. Y., on p. 26 of our last issue, we omitted to state that credit for the design of the buildings is due to Mr. F. L. Garlinghouse, C. E., of Pittsburg. We are informed that Mr. Garlinghouse's plans were selected from a dozen or more offered in competition.

The difference between Mr. Debs and the railway managers as to the status of the railway strike turns on the use of two small words which are generally of very similar significance. Mr. Debs insists that the strike is on. The railway managers say it is over.

The main facts concerning the great railway strike are summarized in an editorial by our English contemporary, "The Engineer," with its usual lucidity and accuracy. We print the following extract, chiefly for the benefit of our Chicago readers:

> A most remarkable strike is in progress in the United States, and we learn without surprise that its headquarters are in Chicago; a marvelous mushroom city, in which are knotted together most of the principal railway lines of North America, and mainly inhabited by a mixed semi-savage population collected from every nation on earth. It is by no means easy to ascertain what the strike is about. * * * The Pullman Company has contracts whereby none but its sleeping cars are allowed to run over 130,000 miles of railroad, and it owns and operates 2,300 cars. All the long-distance traveling in the United States involves the use of sleeping cars; and consequently the railway companies are largely in the hands of the Pullman Company. It appears that the dispute between the company and its hands was not about wages. More than that we cannot say. * * * Pullman is only a few miles from Chicago—a fact very much in favor of the strikers.

The failure of the first Carnegie 17-in. armor-plate under the attack of the 12-in. gun, is another proof of the fact that enormous toughness combined with adamantine hardness of face is necessary to withstand the attack of the 850-lb. projectile from the 12-in. rifle. It will be remembered that the Bethlehem 18-in. plate tested on May 19 (Eng. News, May 31) proved also a failure. Although the Bethlehem plate stopped the second projectile, which the Carnegie plate failed to do, it was practically demolished by cracks, whereas the Carnegie plate suffered no cracks. The behavior of the Carnegie plate was, in fact, very similar to that of the Bethlehem 17-in. plate, not Harveyized, which was fired at by the 12-in. gun a year ago (Eng. News, July 13, 1893). That plate sustained three shots without cracking; but the third shot went through both plate and backing. It appears evident that the Carnegie plate had not been sufficiently hardened in Harveyizing, for the latest record made by a Bethlehem plate (Eng. News, June 14) shows that a 17-in. nickel steel Harveyized plate can be made which will stop the shots from the 12-in. gun without material injury.

It is refreshing to note a change in the tone of the voluminous correspondence on the Brooklyn water supply which has recently appeared in the "Eagle" of that city. As is common in such cases, most of the writers, while entirely unfamiliar with the subject, have assumed knowledge and judgment far surpassing that of engineers who have studied the Brooklyn and other water supplies for years. The less the knowledge of the writers, the longer their letters, until it seemed that the cloudy stream of thought would never be broken. At last two letters appeared in each of which it was urged that the waste of water should be stopped by the use of meters, or what is the same thing, that every one should be made to pay for the water he uses. On the assumption that every one uses the same amount of water through a given class of fixtures, one of these writers stated, the consumer who keeps his plumbing in good repair, allowing neither leakage nor waste, pays for water wasted by his careless or negligent neighbor. If everyone paid for the water he wastes the waste would be stopped and the need for an additional supply decreased in a corresponding degree.

All this sounds familiar enough, but unfortunately a large class of the population of Brooklyn do not know it. Those who do understand the situation are divided into two classes: One wishes to waste water while others pay; the other wishes the consumption to mount as high as possible and the available supply on Long Island to dwindle to apparent insignificance, at least in the popular mind, in order that some scheme to bring in water from a distant source may be furthered. One of the writers mentioned above recognizes the fact that even with a reduction of waste Brooklyn must have more water and urges that the city officials be given money to investigate available sources of additional supply.

Brick paving at 61 cts. per sq. yd. can certainly lay claim to being the cheapest street covering now available. At Bellaire, O., as noted in our "Contract Prices" column this week, a contract has just been let at this figure for 1,100 sq. yds. of hard burned brick paving with gravel and sand foundation. One other bidder offered to do the work for 63½ cts., and the highest bid was only 78 cts. A partial explanation is found in the fact that Bellaire is in the midst of the Ohio brick-making districts and the bricks will be hauled from the yards directly to the streets.

Another city of cheap paving prices is Minneapolis, where a contractor bid 75.7 cts. per sq. yd. for 97,430 yds. of 6-in. cedar block paving on plank foundation, and another contractor is renewing paving, laying new cedar blocks on old planks, at 62 cts. per sq. yd. Prices like these ought to give a great impetus to street improvement work.

The people of Omaha and of Douglas Co., Neb., in which Omaha is situated, are showing much wisdom in thinking twice and in asking for definite plans and guarantees before granting a request for $1,000,000 in bonds to aid in constructing the power canal of the Platte River Canal Co. The Omaha "Bee' insists that the company must agree to make available a specified amount of steady power the year around and to sell the canal to the city or county at a fair valuation, excluding the franchise, the amount donated by the county to be deducted from the purchase price. Regarding the rates to be charged by the company the same paper wisely says:

> We must have a specific limitation of rates for power and water supply. The promise of reasonable rates is too indefinite to be entertained, and would keep us perpetually in the courts to ascertain what is or is not reasonable.

It might be well for the people of Douglas county to consider the query, "Why give $1,000,000 to the company unless the company gives the proper amount of stock in return with representation on the board of directors? In our issues of June 8 and 23, 1893, we outlined and discussed a similar water power scheme, known as the Minnesota Canal, to which Duluth and the county in which it is located were asked to vote $600,000 of bonds and receive stock in return. The people thought the scheme too indefinite and voted it down, 2,170 to 63. In Engineering News of April 12, 1894, the Duluth project was described at length and it was stated that the company was going ahead without public aid, as we predicted it might do.

It appears to be the unexpected that happens in connection with the investigation of methods of filtration at Providence. After the funds had actually been appropriated by both branches of the City Council for a mechanical filtration plant of 15,000,000 gallons daily capacity, it now seems probable that sand filter beds will be built instead. The facts in the case then available for publication were given in our issue of June 28, and on another page of this issue we reprint an official report on the matter by Mr. J. Herbert Shedd, M. Am. Soc. C. E., City Engineer of Providence.

It appears from the information at hand that the City Council decided some time ago in favor of mechanical filtration and that subsequent experiments showed that results could be secured by that method about equal to those from sand filter beds. For some unexplained reason it was believed that the city council could not be induced to appropriate money for any but a mechanical filtration system and such a plant was recommended by the investigating commission, consisting of City Engineer Shedd, Commissioner of Public Works Smith and Health Commissioner Chapin. The commission believed that steps should be taken at once for the purification of the city water, and though the more conservative feeling was for filter beds, mechanical filters were strongly urged because it was thought nothing else could be obtained and there were some important points in their favor.

The original estimate for the mechanical filters was $130,000, which it was urged was much below the cost of filter beds. This sum was appropriated at the start, but upon embodying the results of the investigations in definite plans and specifications the city found that a plant to suit its ideas would cost $281,000. Just after the city council appropriated the additional $151,000 to make up the above, and as a contract was about to be entered into for the filters, a decision in the U. S. Circuit Court held that the use of sulphate of alumina for a coagulant, as was proposed in these filters, is an infringement on patents held by another company, as stated in our issue of June 28. Notice to this effect was served on the city of Providence. About this time Mr. Shedd presented plans for filter beds with an estimate of $208,000 for the construction of a plant with all accessories, and Mr. Smith, Commissioner of Public Works, came forward with a proposition from responsible contractors to build the plant as designed for $200,000. Later the communication, which we reprint, in which some of these facts are set forth, was presented to the city council by Mr. Shedd.

A delegation from the city council, together with the above-named investigating commission, have visited the Lawrence filter beds and the matter is still pending with every probability, so far as can be judged at this time, that filter beds will carry the day. The relative cost of the two methods of filtration is $281,000 and $200,000, respectively, for the construction of the mechanical plant and the filter beds, while the estimated operating expenses are given as $30,000 and, at the outside, $10,000 per year. The city owns the land

on which either plant would be built, hence neither scheme is debited with the cost of the land occupied in the above figures. About 8 acres area (6½ in available filtering surface), is proposed for the filter beds. Of course much less land would be required for the mechanical filters, which is frequently an important point in their favor; but in this case it cannot cut a great figure.

The results of the Providence investigation are of especial interest on account of the fact that an exhaustive and unprejudiced test has shown results from mechanical filtration "about equal to those of slow filtration," to quote from Mr. Shedd's letter. On the other hand, the question of relative first cost and cost of operation, on which advocates of mechanical filters have based large claims to superiority, appears to have been decided in favor of the filter bed system, the bids for each showing a cost per million gallons of daily capacity amounting to $15,733 for the sand beds against $18,733 for the mechanical plant. Inspection of the detailed plans and specifications might explain in some degree the heavy cost of the mechanical plant; but that it should be discarded in competition with sand filter beds on account of excessive first cost will doubtless surprise many engineers.

THE BROCKTON SEWERAGE ASSESSMENT PLAN.

Of the many perplexing problems which engineers are called upon to solve outside of their strictly professional work perhaps none is more troublesome than the devising of an equitable system for raising money to defray the cost of certain municipal improvements, notably sewerage systems and street work. At first thought it might seem that such tasks should be left entirely to the financial officers of the communities concerned, but it often happens that these officers have never coped with such problems and know nothing of the way in which they are handled elsewhere. Moreover such improvements are being extended from year to year to meet the growth of cities. These extensions, as well as the operation, repairs and renewals, must be provided for, and involve questions with which local financiers are generally quite unfamiliar. In fact, through observation and experience, the engineer often has far more knowledge of certain classes of municipal financiering than officers directly in charge of such matters, especially as the latter more often owe their position to politics than to fitness for office. In most of the smaller, and many of the larger, cities the whole financial policy is framed by the legislative branch of the city government, the members of which know little about municipal financiering and even less about public works.

It is not strange, therefore, that there is such a diversity of methods in what are commonly called assessments for benefits, and that engineers are now and then called on to formulate or aid in formulating a policy.

The most recent and valuable addition to the theory and practice of this subject has been made by Mr. F. Herbert Snow, City Engineer of Brockton, Mass., in the shape of a lengthy report on the best method of raising money to meet the cost of building and operating a sewerage system now being constructed for the city of Brockton, with Mr. Snow as engineer. This system includes a receiving reservoir, pumping station, force main and filter beds, made necessary for the purification of the sewage. The city has a population of about 30,000, having increased from 13,608 in 1880 to 27,294 in 1890. Up to July 9 the city council had not adopted the assessment plan, but it was thought probable that it would do so.

In arriving at the proper plan for Brockton, Mr. Snow studied with great care the various methods of assessments already in use, after first having shown that the benefits of a sewerage system were partly public and partly private, and should be borne accordingly. Public benefits are, of course, to be met by general taxation. The proportion to be paid by the public has been fixed by the Massachusetts legislature at not less than one-fourth nor more than two-thirds of the total cost of the sewerage system. For private benefits a variety of methods are permitted by the statutes, such as frontage and area assessments, yearly rentals, entrance fees, or a combination of these.

Either the frontage or the area plan alone is shown by Mr. Snow to be inequitable, diagrams being used to illustrate how by either plan differences in the shape of lots may allow several houses on one lot and only one or two on another, each lot having the same area or frontage, as the case may be. The entrance fee is also shown to be unjust, unless it is graded in accordance with benefits received, while, in addition, a large fee would be required at the start, when there were but few connections, or else reliance on the general tax levy would be necessary.

The method finally recommended by Mr. Snow is given in his report as follows:

> It is recommended that one-fourth of the total cost of the sewerage system be raised by first assessment, one-half by rental, and the remainder by general tax. It is also recommended that first assessment be based on area and frontage of land adjacent to sewers —0.6 on area within 125 ft. of the street line and 0.4 on frontage; that the first assessment be collected in one payment and credited to construction account; that the unit of rental be 1,000 gallons of water reaching the sewer, this to be ascertained from meter gagings of the water department, and to be corrected for water finding another outlet than the sewer by a system of discounts; 70% to be deducted from water supply of shops and 20% from water supply of houses having sill-cocks.
>
> And it is further recommended that abuttors be not compelled to enter the sewer as soon as completed; that no one be allowed to enter without a permit; that no rent be charged users before Jan. 1, 1895, rents starting from that date; that such rents be charged from the first of the month following that in which the permit is dated; and that all deficiencies be made up in the early years by general tax levy.
>
> It is further recommended that the following prices be assessed per unit: For first assessment, 0.3 cts. per sq. ft., and 15 cts. per front ft.; for rental, 28 cts. per 1,000 gallons entering the sewer; and that $8.40 be charged for unmetered connections, subject to a discount of 20% for sill-cocks.

The plan having been outlined above, it may be considered in detail, taking up at the start what Mr. Snow terms first assessment, or one-fourth of the entire cost of the sewerage system, including pumping plant, filter beds and accessories. It is evident that the total cost of a system covering the whole city must be considered here. This is estimated at $1,300,000. The frontage to be assessed was taken as 971,000 ft., and the area, 125 ft. from the street, as 80,537,000 sq. ft. This gave 13.4 cts. per ft. as the frontage, and 0.24 cts. per sq. ft. as the area assessment, which rates were for convenience increased to 15 and 0.3 cts. respectively. It is proposed that 60 ft. of the frontage of corner lots be exempted and that no area be twice assessed. Mr. Snow states that at the start the amount of money raised in this manner will not equal one-fourth of the total cost, which will be high at first in proportion to the area served, but that eventually the proportion will be reached and that meanwhile the deficiencies may be made up from general taxation. It is evident that this need cause no trouble, since it is proposed to use for extensions the money derived from first assessments, the total cost of the sewers already built having been raised by selling bonds. The amount of bonds necessary for extensions will in this way be lessened as will future interest, and, therefore, maintenance accounts. These first assessments represent the value of the sewerage system to land, in enhancing its price without regard to whether the sewers are used by the owners of the land. The amount raised by general taxation will likewise represent the benefit to the community as a whole, without regard to the location of the sewers. Benefits from actual use of the sewers are to be paid by rental, according to the amount of sewage contributed, and the sums so raised will be applied to paying off the bonds, meeting interest, and to maintenance. The rentals will pay two-thirds of the total yearly charges, leaving the balance to be met by general taxation.

It is eminently fitting that rental should be based on the amount of sewage contributed, since upon the latter depends the size of the sewers, and notably the cost of constructing and operating the pumping plant and filter beds. Fortunately at Brockton 65% of the water connections are metered and the records of the water department are well kept, so that the sewer rentals can easily be based on the water consumption. Obviously on many premises some of the water used does not find its way to the sewers, hence the proposed deduction of 20% of the consumption for houses having sill-cocks for hose and of 70% for shops. Where shops use a large amount of water and it is felt that 70% is too small a deduction, the proprietors can afford to put in a special meter. This method permits of co-operation between the water and sewer departments and prevents conflict or dissatisfaction that might arise in case the two departments used a different basis of assessment.

The unit of 28 cts. per 1,000 gallons of water was arrived at by computing the probable yearly expenses of the sewerage system until 1900 and the probable water consumption for the same period. It should be stated that the water consumption in Brockton is phenomenally low, only 25 gallons per capita. The yearly rate of $8.40 for unmetered houses was chosen because the minimum rates for metered water are such as to make it an object to water users to have a meter when the water consumption goes above a point that would call for such a rental.

Coming to the amount to be raised yearly in the tax levy, the problem is simple, the amount being the difference between the total amount to be raised and that provided for as outlined above.

Although this system has been worked out to meet the situation of Brockton, which is in a number of respects unique, the general principles involved may be applicable in other places. The special conditions at Brockton are as follows: (1) No sewers are yet in use, although the city has a population of about 30,000; this renders possible the adoption of any desirable system without the unfairness, real or fancied, which follows a change in the case of old systems. (2) It is expected that the whole city will be sewered in a comparatively few years, so that the total cost of the system can be readily estimated, which is essential to this plan. (3) The large percentage of metered water taps and the fact that the city owns the water-works, so that water and sewer departments can co-operate, while each desires to keep the water consumption down, are favorable to a yearly rental plan, based on water consumption. Modifications of these conditions might make the system difficult of application or might cause friction when applied. Nevertheless the principles at the bottom of it seem correct, and this general distribution of the burden of a sewerage system, whether in these or other proportions, seems fair and likely to be popular. General public and individual private benefit are each recognized and the latter is divided into two classes, (1) potential benefit through increased value of a certain piece of property because the sewer passes by it and may be used, and (2) the actual benefit through use.

Two dangers which beset the extremes of the two methods most usually employed to raise money for sewers seem likely to be counteracted to a large extent by this plan: (1) When the whole cost is put in the general tax levy or is met by bonds, the interest and principal of which must be met by taxes, it is difficult to secure money for extensions, every taxpayer wishing to keep the rate down, and those living on sewered streets having no direct interest in extensions. In the Brockton plan the tax levy is increased by only one-fourth the total cost of the sewers, the bulk of the expenditure being put upon those whose land is improved or those who, by use of the sewers, are saved the expense of cleaning cesspools or privy vaults. The taxpayer feels that the sewerage system is, to a large extent, self-sustaining, like a municipal water-works plant. (2) The other danger is that where property benefited bears the whole expense of sewers it will, in case of assessments for frontage or area, try to keep the sewer out of the street. But in Brockton a given property owner will be paying towards one-fourth the cost of the system whether the sewers are in his street or not, and once in his street he need pay only an additional one-fourth for property benefit, unless he wishes to connect with the sewer. The sewer once in, however, he will already be paying towards one-half of the total cost of the system and the additional expense for the use of the sewer will seem small. Moreover, by economy in the use of water his rental may be kept low, and most people do not consider themselves extravagant water users.

A third extreme which may be considered although it rarely occurs in practice, except in the few instances where sewerage systems are owned by private companies, is the levying of the whole cost upon the user in the form of a yearly rental

for discharging into the sewer. This plan, when adopted, is likely to result in a comparatively heavy expense to the users of the sewers, as all not connected with the system contribute nothing towards its cost and maintenance. It discourages sewer connections, especially from owners of small houses and of tenement property. In Brockton only 50% of the cost of sewerage construction and maintenance is levied on the users, and the sums so raised are based on the future as well as the present use of the sewers, which tends to lessen the individual payments, while the users know that all the property in the city is bearing a part of the burden.

Altogether the Brockton plan has much to commend it and its practical operation will be awaited with interest. Mr. Snow has given to this subject the same patient and exhaustive study that he gave to the designing of the sewerage system, especially the purification plant, and he deserves high commendation for both pieces of work.

TRACK ELEVATION IN CHICAGO.

After nearly two years of preliminary investigation and negotiations, an agreement has finally been reached by which two of the large railway systems entering Chicago will abolish all crossings at grade by elevating their tracks to pass over the city streets. Following the sweeping ordinance passed by the City Councils in February, 1893 (Eng. News, March 9, 1893), which required all railways to begin elevating their tracks by June, 1893, the progress noted may not seem to have been great, but a very brief consideration of the conditions and of the magnitude of both the work itself and the financial interests involved shows that it is quite as much as could be expected. Measuring either by the cost or by the importance to the welfare of Chicago, the removal of grade crossings on the railway tracks entering the city is second only to the work now in progress for purifying the city's water supply and disposing of its sewage by the great drainage canal. Of course a vast deal of labor will still be required to adjust the conflicting interests and assure the success of the plan to abolish grade crossings; but the entering wedge has been started, and the prospect that something will be done to carry out the great work is so good that it seems worth while to review somewhat at length the history of the movement and the conditions which have necessitated it.

Practically the first step toward the solution of the grade crossing problem in Chicago was taken in February, 1892, when the City Councils passed a resolution authorizing the mayor to appoint a commission of three members to report upon the best plan for doing away with the nearly 1,500 crossings of streets and railway tracks at grade then existing within the city limits. This commission presented a preliminary report in May, 1892, and a final report about three months later (Eng. News, July 21, 1892) and recommended that all tracks should be elevated 16 ft. above the street surface, but that in order to reduce the number of tracks to be elevated, and also to furnish a part of the money for carrying out so great a work, that all or nearly all of the railway tracks north of Twenty-second St. on the South Side be abolished, and that the three great union stations be moved out to Twenty-second St.

While the elevation of the railway tracks was without doubt the best solution of the grade crossing problem for so level a city as Chicago, yet the plan proposed was at once criticised, first, because it contemplated too radical a change of existing conditions, and, second, because it treated all the railways alike without regard to their different circumstances and locations instead of treating separately certain groups of railways having common interests. As a consequence of this report, however, the City Councils passed an ordinance in February, 1893, requiring all railways to begin elevating their tracks by June of that year and to have the work completed by June 1, 1899. The full conditions of this ordinance were given in our issue of March 9, 1893, and need not be further stated, except to say that it required a uniform elevation and system of construction and made the roads responsible for all land damages. The minimum clear height of the elevated structure above the street surface was placed at 16 ft. As we stated at the time, this ordinance was one which the railways would not be likely to accept unmodified without a struggle in the courts.

The first company to take any action upon the ordinance was the Pittsburg, Ft. Wayne & Chicago R. R., wh'ch submitted a plan to the City Councils, in which it proposed to elevate its tracks 9 ft. and depress the crossing streets 5 ft., besides making various other changes and modifications from the plans contemplated in the original ordinance. Mr. G. H. Ellers, the consulting engineer for the city, after considering the proposition, submitted a plan which was a mean between the maximum elevation required by the ordinance and the elevation proposed by the railway. This was in substance that the tracks should be elevated 10½ ft. and the cross streets depressed 3½ ft. No action was taken by the company on this revised plan.

The next move was made by the Chicago, Rock Island & Pacific and Lake Shore & Michigan Southern railway companies, which submitted plans for elevating their tracks for a distance of 5½ miles. These plans differed still further from the conditions of the original ordinance. Mr. Ellers made some modifications of these plans and embodied the whole in an ordinance, which was passed by the City Councils in March of this year. The conditions of this ordinance were given in our issue of April 26. In brief, they required an elevation of the tracks of from 4 ft. to 10 ft. and depressions of the cross streets of from 1 ft. to 9 ft. below their present grade and called for a minimum clear headway of 12 ft. With these depressions the grades of the street approaches varied from a fraction of 1% to 4.9%, being in most cases over 3%. As stated in the article last referred to, the railway companies refused to accept these conditions and suggested counter modifications. These were practically agreed to in the ordinance passed by the City Councils last week, as stated in another column. As will be noted, the principal change has been an increase of 1½ ft. in the elevation of the tracks and a corresponding decrease in the depression of the streets.

In the above condensed record of the track elevation movement, only the main facts have been noticed, as the chief object has been to bring out the evident change which has gradually taken place in the ideas of those promoting the movement regarding the maximum elevation of the tracks necessary and the desirability of a single general plan applicable to all roads entering the city. The original ordinance followed the recommendations of the commission in requiring a clear headway of 16 ft. between the elevated structure and the street curb level and little or no depression of the streets at the crossings. The ordinance just passed materially reduces the headway and allows a very considerable depression of the streets. Further, the first ordinance implied a single general plan for the elevation of all railway lines, and the present ordinance applies to two railways only, and as far as known was drawn without much reference to what the plans of the other roads for the elevation of their tracks might be.

As was to be expected, opposite factions have developed in the City Councils, one of which favored adherence to the original plans, while the other, headed by the mayor, has put through the modified ordinances. On behalf of the policy of treating separate roads or groups of roads independently, it is claimed that no system or plan can be devised which will be applicable to all the railways within the city, for the reason that the conditions are so different and the interests so diverse that an attempt to formulate a general plan which would work well in actual practice and be accepted by the railways would result in a failure. This is undoubtedly true in a very large measure, although perhaps no other city in the world affords an equal opportunity for the application of such a general plan of track elevation as was contemplated in the original ordinance on account of the almost uniform level of the land on which Chicago is built. It is further urged that certain pairs or groups of lines have common interests and work largely under common conditions in respect to their routes and terminals and that a common plan for the elevation of their tracks can easily be adopted. In other words, immediate action looking to the removal of grade crossings can be obtained only by treating each road or group of roads having common interests as a separate case.

Beyond the question of the desirability of a uniform plan of track elevation in Chicago comes the question of securing the co-operation of the railways in hastening the work of elevation so that the abolition of the 1,500 grade crossings with their harrowing record of annual fatalities may be effected as soon as possible. This co-operation will be difficult or impossible to secure from all the roads in any event and very few roads can be induced to co-operate if a uniform elevation of all roads is demanded. Indeed, it will be strange if a legal fight will not be necessary in any event before some of the companies will make any move toward elevating their lines. While the outcome of any such contest would probably be an ultimate victory for the city, yet the law's delay is proverbial and should be avoided where possible even at considerable sacrifice. Concerning the policy of decreasing the elevation of the tracks and gaining the necessary head room by depressing the streets, it is claimed that this is a necessary concomitant of the plan for elevating each road or group of roads separately. Some of the roads pass through the older parts of the city, where real estate is very valuable and the structures along their routes could be changed only at great expense. In such cases, change of the street grade must be made as small as possible, and a higher elevation of the track is therefore demanded than for other roads which pass through the newer sections where a modification of the street grade at the present time will do little damage.

Of course the proposal to introduce a depression in the street of from 1 ft. to 7 ft. met with much opposition from those who contended that the railways should do all the elevating and leave the streets level. But the fact really is that such a depression is by no means a serious matter. For all light vehicle traffic it is of course of no importance whatever, and as respects loaded teams, if properly driven, they will haul through a sag of 4 to 6 ft. any load which they can move at usual street pace on a level, gaining impetus in descending one slope to climb the opposite one. As elsewhere noted, the railways have the burden of paving, lighting and draining these subways underneath the tracks, so that any question of interference with sewer systems, etc., is eliminated. On the whole, therefore, the citizens of Chicago may feel that they are being very fairly treated by the two railway companies which are the first to fall into line with the track elevation movement.

On the other hand, the principal officers of the two railway companies are to be congratulated on their breadth and enterprise in undertaking this work. The expense involved is of course enormous, but it is an investment which must be made sooner or later, and it is worth while to take advantage of the very low prices which are now current. It is to be borne in mind, moreover, that it is an investment which is destined to yield a considerable return. The present heavy annual outlay for gatemen at crossings and for damage suits brought on account of persons killed and injured at crossings, represents the interest on a very large sum of money. There will be further gains in the increased facility of train movements, especially in handling passenger traffic; and the rental of the space formerly occupied by surface tracks can be made to yield a considerable income.

Whether the example of the Rock Island and Lake Shore companies will be followed by others, remains to be seen. The unfortunate occurrences of the past two weeks have done more to complicate and make difficult the problem than may be realized. The railways cannot elevate their tracks, no matter how good a will they may have to do so, unless they can raise the money from the investing public; and the investing public, it is safe to say, has not been favorably impressed by the wholesale burning of freight cars that has been such a feature of this latest great railway strike. Perhaps, however, if the city of Chicago acknowledges its financial responsibility for the damages sustained by the railways within its limits, it will have some effect in persuading investors that the railways still have some protection at the hands of the law.

LETTERS TO THE EDITOR.

THE USE OF COAGULANTS IN MECHANICAL WATER FILTERS.

Sir: Referring to the article in your issue of June 28, on the recent decision of the U. S. Circuit Court as to the use of coagulants in mechanical filters, we respectfully call your attention to the enclosed joint letter. Yours truly,

The Morison-Jewell Filtration Co.,
S. L. Morison, V.-Pres. and Gen. Man.

New York, July 17, 1894.

To Those Using or Proposing to Use Mechanical Filters:

We understand that the New York Filter Co. has been sending notice to many users of mechanical filters, calling attention to a recent decision of Judge Shipman in a suit against Henry Schwarzwalder, et al., in which the Hyatt patent for the use of a coagulant in connection with mechanical filtration is held valid, and threatening suits for infringements thereunder.

We desire to inform you:

That none of the users of our filters need have the slightest apprehension on account of such threats, as neither the said patent nor the said decision affects in any way the use of a coagulant in our filters;

That we are not parties to the said suit;

That since the said decision was rendered we have discovered abundant evidence of the use of a coagulant in identically the same manner as claimed by the Hyatt patent, and long antedating the patent upon which the New York Filter Co. has based the above suit.

That we have submitted the matter to eminent counsel and are informed that this evidence clearly proves the invalidity of the above patent, and we therefore cordially invite the threatened attack on us, or on any of our customers, and we hereby agree that we will, when such attack is made and suit brought, jointly undertake the defense and assume the costs of the same.

The Cumberland Manufacturing Co.,
Joseph T. Manning.
The Moore Filter Co.,
The Morison-Jewell Filtration Co.,
The Western Filter Co.

New York, July 12, 1894.

THE PHILADELPHIA ASPHALT TESTS.—A CORRECTION.

Sir: In our letter of reply on the asphalt paving question, published in your issue of July 5, we stated that we were informed that "Mr. Clifford Richardson was at present an official of the Barber Asphalt Co." We did so on what we considered reliable authority from two different sources. Mr. Richardson has written to inform us, however, that this statement is incorrect, and that he is not in any way connected with the company named. We desire, therefore, to correct our statement, lest we should do Mr. Richardson an injustice, which was foreign to our intention in writing on this subject. Very respectfully,

Sam'l P. Sadtler,
Henry Leffmann.

Philadelphia, July 12, 1894.

A NOVEL STREET SURVEY MONUMENT.

Sir: I note in your issue of June 7 the remarks on Street Survey monuments. I would like to add the description of a monument which I believe is superior to others in many respects, and is beyond question durable. Its construction is as follows: Bore a hole in the ground, if possible, with a post hole augur of any dimension, say, from 4 to 8 ins. in diameter and about 5 ft. deep. If boring is impracticable then dig and insert a conical form and make a hole. Next center a stem of durable redwood or cedar about 1 in. square by 5 ft. long in exact position in the hole, and holding the top in true position, pour into the hole and around the stem either freshly slacked lime or lime previously prepared to the consistency of cream. Fill the hole to the top, or drive the stem below the surface and cover with a movable stone or plate. Some might prefer a mixture of cement and lime, or all cement. For road monuments I prefer the lime.

The value of this kind of monument is in the color of the lime making it foreign to the surroundings, easily found, not liable to be mistaken, and indestructible. No roadmaster in his annual plowing of the roads can destroy it. The fragile stem for the center is desirable, as it is better to break off a part of its length with plow scraper or wagon wheel than to disturb its position. It is more likely to be driven down than moved sidewise.

The redwood, and, in fact, almost any wood encased in lime, is good for many years. This style of monument, I think, embodies many desirable features, especially permanency, which ranks first in a surveyor's work. Yours truly,

Geo. C. Power, M. Am. Soc. C. E.,
City Engineer.

Ventura, Cal., June 28, 1894.

A MIRROR ON A LOCOMOTIVE.

Sir: I would like to know if a reflector on a locomotive would be any benefit to an engineman? It would be placed above the bell so as to be higher than the cab, and the rear end of the train could be seen at any or all times by the engineman, if this would be of any benefit to him, which I think it would. In case a train parted, and in leaving stations and railway crossings or wherever an accident happens to the rear end of a train, or where a brakeman falls between the cars, an accident might be avoided if the engineman had this reflector. C. E. F.

Dixon, Ia., July 10, 1894.

(While it might be possible to place such a reflector on the engine, it would have to be so large in order to be of any service that its use would hardly be practicable, while the swaying of engines and cars, crowds at stations, etc., would prevent it from being of much service. In running, the engineman could not give very much attention to the mirror, and it would be only by chance that he would see in it the occurrence of the accidents referred to. In general, the main and great duty of the engineer is to keep a sharp and continuous lookout ahead, and other calls upon his attention should be as few as possible.—Ed.)

BACTERIA IN DRINKING WATER.

Sir: It has been customary of late to base the efficiency of water filters on the percentage of bacteria removed. A word or two on this subject may not be amiss.

If the source of water supply is beyond the reach of sewage contamination, the probability of finding pathogenic bacteria in such water is very small, because the bacteria of which we stand in awe, the typhoid and cholera germs, are not indigenous to water, but are always imported into it, generally from sewage sources. While the organic matter in a sample of water may be relatively large, if it is certainly known that this is not from sewage or semi-sewage sources, then the chance of the water containing bacterial life or micro-organisms dangerous to health is remote.

Upon the other hand, if the water source, whether it be an impounding reservoir, lake, river, well or cistern, be exposed to sewage contamination, then any bacteria in such water should promptly condemn it for drinking purposes. In brief, water which receives sewage can be rendered safe for drinking only through sterilization by heat. No stream which receives the purified (?) effluent from a system of sewage disposal on the precipitation plan can be regarded as a safe source for drinking water.

It is a singular fact that in many instances where pathogenic bacteria have been found in water, excepting, of course, sewage effluents, the number of bacteria of all kinds per unit of volume of the water is small. Thus Dr. Victor C. Vaughan, in a well water containing so few as 20 bacteria per cu. cm., had found germs fatal to the lower animals, and from collateral evidence presumed to be fatal to man, while lake water from the same locality containing 5,300 bacteria per cu. cm., was harmless when inoculated into the lower animals.

Again, artesian well water containing only 10 germs per cu. cm., was fatal to the lower animals, while river water from the adjoining county, containing 3,000 bacteria per cu. cm., was harmless to the lower animals.

In some tests of water for the city of Rochester, N. Y., several years ago by Dr. H. C. Ernst, of Harvard, of several samples examined that one which contained the fewest bacteria gave the largest variety, and was the only sample known to contain the typhoid germ.

A statement therefore that by a certain process of filtration the number of bacteria in a given water has been reduced from 1,000 to 4 per cu. cm. is not convincing proof of the capacity of such filter to eliminate disease germs; because 4 bacteria per cu. cm. means upwards of 1,000 in a single tumbler of water, and among 1,000 bacteria left in any water there is a possibility that some may be disease germs, provided such were in the water before filtration.

Respectfully, John W. Hill.

Cincinnati, O., June 28, 1894.

(It might perhaps be inferred from the above that the percentage of bacteria removed by a filter should not be taken as a measure of its efficiency, but doubtless the writer did not mean to convey that idea. This possible confusion arises from the apparent challenge of this standard in the opening sentence and from the fact that in the last paragraph conclusions drawn from bacteriological examinations of unfiltered water are applied without qualification to filtered water.

When purification of a drinking water is attempted by filtration the object is to so treat the water that it may be delivered to consumers free from disease germs. Because of the difficulty of isolating disease germs from the other bacteria in water reliance must be placed upon the number of bacteria removed without regard to kind as an index of the degree of purification attained. We note, however, as a matter of interest in this connection that of the 2% of bacteria remaining in the water which passes the filter beds of the Lawrence water-works it is said that none are typhoid germs, a statement which seems to be largely borne out by the great reduction in typhoid fever in the city since the filters were put in operation, as well as by the exhaustive observations of the Massachusetts State Board of Health. Moreover, filtration renders water less capable of supporting bacterial life, so that if 98% of the bacteria in a given water are removed by filtration the 2% remaining are very likely to be still further reduced before the water reaches the consumer. Percentage of bacteria removed, therefore, is the best available standard for judging of the efficiency of water filters.

When passing upon the relative merits of different sources of supply the problem is altogether different, and standards here should not be confounded with those for the efficiency of filters; but still the relative number of bacteria, as well as the chemical determinations and the probable sources of contamination, may well be taken into consideration. The ideal way would be to adopt no new and abandon all old sources of supply known to be subjected to sewage contamination; but waters absolutely free from possible sewage contamination are only to be found in tracts of country which are practically uninhabited. Relative purity only is the question to be solved and the acceptance or rejection of a source of supply means thousands or hundreds of thousands of dollars. In such cases the most careful examinations known to modern science must be made and the results should be interpreted with equal care.

For the benefit of any who may be interested, it may be stated that the bacteriological examinations by Dr. Ernst, referred to in the above letter, are given in detail in the report of the Executive Board of Rochester, N. Y., for the year ending April 7, 1890, in a special report by Messrs. Geo. W. Rafter, M. Am. Soc. C. E., and M. L. Mallory, M. D., on "An Epidemic of Typhoid Fever at Springwater, N. Y." The water which is reported as containing the typhoid bacillus was from a grossly polluted surface well and showed 9.6 parts per 100,000 of chlorine, the normal chlorine of the locality being given as 0.13 by Mr. Rafter. This identification of the typhoid germ in drinking water was credited in the above report as the fifteenth to the close of 1889, one other identification having been made of the germ in air. The identification was chronicled as an important bacteriological event, and we believe well attested identifications are still a novelty.—Ed.)

THE FILTER QUESTION AT PROVIDENCE.

An interesting contribution to the discussion of water filtration methods, with especial reference to the relative efficiency and cost of mechanical filters and of sand filter beds, is the report of Mr. J. Herbert Shedd, M. Am. Soc. C. E., City Engineer of Providence, R. I., to the Mayor and Board of Aldermen of that city. In our issue of June 28, 1894, we outlined the filter situation at Providence, and stated that sand filtration might finally be adopted in place of the proposed mechanical plant. Mr. Shedd's communication is as follows:

In the matter of establishing a filtration plant for the water-works of Providence, it may be said that the value and efficiency of slow filtration through sand for purifying water for domestic use has been known for a very long period. There can be no question as to the satisfactory result of treating Pawtuxet water by such a process, but it has seemed desirable to secure the required purity by a less expensive method, if practicable. Persons who hold patents for clearing water of impurities by rapid filtration through sand have been persistent in the claim that their processes can be established and run at much less cost than that of the well-known and much used slow filtration. It was asserted that an efficient plant, capable of satisfactorily filtering 15,000,000 gallons of Pawtuxet water daily, could be established for the city of Providence at an expense not exceding $130,000. This being much

less than the supposed cost of a good system for slow filtration the question arose whether good results could be secured by the rapid process. To answer this question in relation to the Pawtuxet water, and to gain information which would be needed in putting up and running such a plant, a series of experiments was undertaken and continued for about a year at our main pumping station. It was found that with proper care and skillful attention, results about equal to those of slow filtration could be secured. Such experiments as have been made by the Massachusetts State Board of Health indicate that the efficiency of the mechanical or rapid filtration is not so reliable nor so uniform as the slow filtration; but our experimental results were fairly satisfactory in that respect.

Having found that good results are practicable with a mechanical filter plans for establishing a plant in connection with the Providence water-works, capable of filtering 15,000,000 gallons daily, were made and a bid was invited thereon. The result indicated that such a plant would cost about $281,000. This was a much greater cost than had been originally considered and was, in my opinion, greater than the cost of an efficient and satisfactory plant for slow filtration. I also believed that the slow filtration would prove more simple, more durable and would involve much less annual expense, but circumstances seemed to require the adoption of mechanical filtration or none, and I sincerely recommended the adoption of mechanical filtration rather than to allow the city to wait, perhaps for years, without filtered water and run the risk meantime of epidemics of fatal diseases which could be effectually prevented by proper filtration.

Now that circumstances appear to have changed, and the whole subject may apparently be considered on its merits, a simple statement of some of the experiences of other communities with slow filtration seems desirable. The city of London has been able to supply Thames water to its inhabitants and maintain their healthy condition by passing the water slowly through sand filters of large area. Success has attended this method now for more than 40 years, and no change in the process appears to be desirable. Many large cities on the Continent of Europe have adopted the London plan and have practiced it for long periods with satisfactory results.

In Massachusetts, in the last few years, much attention has been given to the subject of purifying public water supplies. Extensive experiments have been carried on by the Board of Health for about seven years and careful and scientific observations have been made on the effect upon water of filtration through sand. Their results have led the Board to approve slow filtration as a proper means of purifying water for domestic use in large quantities.

The city of Lawrence had long suffered excessively from typhoid fever caused by drinking the water of the Merrimac River, which received the sewage of Lowell, that, in its turn, suffered from the effect of evacuations of typhoid patients turned into the river above that city. "The city of Lowell, with a population of 78,000 had, in the year ending April 1, 1891, 150 deaths from this disease, and the city of Lawrence, with 45,000 inhabitants, had 78 deaths." Lawrence had for several years more than twice the average of the cities of the state, in deaths from this cause. Lawrence and Lowell "are the only cities in the state which draw their water for drinking from a river, into which, within 20 miles above, sewage is publicly discharged." The chairman of the Committee on Water Supply of the State Board of Health has stated that:

> The amount of sewage that has directly entered the river and its branches during the chemical examinations of the past three years is estimated to be about 1 gallon in 600 gallons of the river water passing Lawrence, and there has been no more impurity in the water that could be detected by chemical analysis than in about one-half of the drinking water supplies of the state obtained from ponds and streams; but the facts which have been presented showing that these two cities have so much higher death rates from typhoid fever than any other cities of the state, together with what is known of the relation of typhoid fever to sewage-polluted drinking water, are the strongest grounds for concluding that even with the small amount of organic impurity in the water, as shown by chemical analysis, the germs of this disease are able to pass, and do pass, from one city to the other in the water of this river.

Under these conditions the city desired to know if the water could be purified by filtration. The Board of Health replied:

> It would be essential in this case that the germs of this and other diseases should be destroyed by the process of filtration. Of the many filters which the State Board of Health has experimented with, there is one which has filtered daily for three years at the rate of about 300,000 gallons per acre per day, and it is believed that no bacteria have survived the passage through it. * * * Of the more rapid filters the Board has not yet found one, used either with or without alum, that removed all the bacteria.

Under the advice of the State Board of Health and under direction of Mr. Mills, the engineer member of the Board, the city of Lawrence constructed a sand filter having an effective area of 2½ acres and intended to filter 5,000,000 gallons of water daily. This filter has been in active and successful operation since Sept. 20 of last year, having an effect upon the health of the citizens which is marked, and causing expressions of satisfaction with its effect which are hearty and general throughout the city. The water board in their last report say:

> From the day of letting on the water to the present there has been a continuous and ample supply of filtered water received into the pump wells and pumped into the reservoir. The construction of this sand filter has proven the theory that water can artificially be made pure and wholesome, and from the best scientific advice we can now say that the city of Lawrence enjoys the benefit of as pure water as any city in the country.

While the deaths from typhoid fever previous to filtering its water supply averaged about four per month through the year, though the number per month varied with the seasons, the number of deaths in October was one; in November was one, and that one was known to have used unfiltered river water; in December, two; in January, two, one of which was known to have used unfiltered river water; in February, five, four of which were known to have used unfiltered river water; in March, four, three of which were known to have used unfiltered river water; in April, none; in May, two, one of which was known to have used unfiltered river water, and in June, to the 27th, when the visitors from Providence were there, none. It thus appears that when from previous experience about 36 deaths from typhoid fever might have been expected, only 7 deaths occurred, in addition to those known to have used the unfiltered water.

The city of Hamburg in Germany, with a population of 600,000, has seemed to find it necessary to continue the use of the Elbe River water, in spite of its unwholesome condition; but it has recently constructed the usual sand filter for the slow filtration of this water. I quote from the "Century Magazine" for the present month of July the following:

> As the prime sanitary reform, it was determined to construct the greatest and most complete filtration plant in the world to supply the city with an unlimited quantity of Elbe water purified to meet the severest tests of chemist or bacteriologist. The new works were under construction when the frightful cholera epidemic of 1892 swept away thousands of victims. It was demonstrated that the disease had been propagated through the use of Elbe water, and that filtration would remove the cholera germs. The new works were to have been ready for use in 1894; but by great effort they were completed and put into operation in May, 1893.
>
> During last summer and autumn, the river water, when introduced into the subsidence basins and filters, contained millions of cholera germs to the cubic inch. As it emerged, and was supplied to the city, the water was as safe and wholesome as if it had been brought from high Alpine sources. The filtered water averted the return of the epidemic in 1893. So striking an object lesson in municipal health administration has never been presented before, and its effect will have been felt everywhere in Europe.

The construction of sand filters for slow filtration is not an experiment. Their use and value have been demonstrated in great numbers of cases and through long periods of years. The only reasons that I know for departing from this long-established practice is in the effort to get cheaper first cost, or because the necessary area for their establishment is not available. In the case of the city of Providence there are about 70 acres of suitable land near the pumping station bought for this purpose more than 20 years ago, and still available. Since it has been found that a mechanical filter is likely to cost $281,000, plans have been made, levels taken, test pits dug and estimates made for a sand filter for slow filtration on that land, with all necessary settling space, supply conduits and screens, leading mains and other appurtenances complete for connecting the plant with our present works. My estimate of the cost of supplying all materials and doing this work is about $208,000; but whether my estimates have any value or not, the Commissioner of Public Works has in his possession a bid from responsible contractors who offer to do the whole work complete for $200,000.

The cost of annual maintenance of the slow filtration plant will be, I think, very materially less than the cost of maintaining a mechanical plant of the same daily capacity.

I have received from the superintendent of the Lawrence water-works a letter, of which the following is a copy:

> Lawrence, June 28, 1894.
>
> Mr. J. Herbert Shedd, City Engineer, Providence, R.I.
>
> Dear Sir: I cannot give you the exact cost of cleaning our filter beds, but think it will cost about $1,500 or $600 per acre per year, not including the cost of sand. The cost of cleaning filter for Pawtuxet water must be very much less, as you would not have to contend with the silt that we have in the Merrimac water, which gives us the greatest trouble, as it retards the flow of water through the sand.
>
> Respectfully yours, A. H. Salisbury.

An expense of $600 per year per acre for 7½ acres amounts to $4,500, which is less than one-third of the estimated cost of chemicals alone for the mechanical plant.

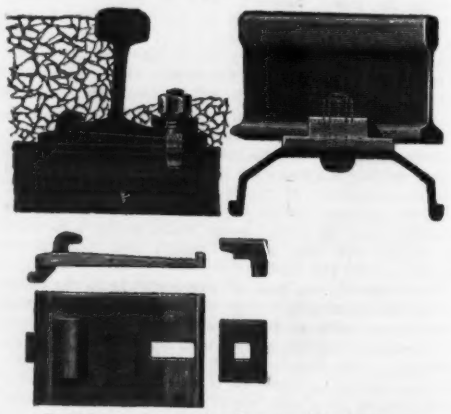
DO IRON AND STEEL CRYSTALLIZE IN SERVICE?

A paper with the above title by Mr. Paul Kreuzpointner, of the Pennsylvania R. R. testing department, is published in the "Iron Age" of July 5, in which the author combats the theory still commonly held that iron and steel assume a crystalline structure when placed under continued strain, or when subject to shock or vibration. After citing various evidence in support of his position, the author sums up with the following conclusions:

1. Crystals are the product of the solidification of chemical elements through their cohesive attraction.
2. Dissociation or dissolution, by means of heat or moisture, of the chemical elements in the body in which they are combined for the time being, must precede the process of cohesive attraction and subsequent formation of crystals.
3. Such dissociations and change of form of the chemical elements of carbon, etc., combined with the iron, will take place only under the influence of heat.
4. "Cold short" (high phosphorus) scrap mixed with the "pile," overheating of the "pile" or ingot (if steel) and subsequent insufficient work to break up the crystals formed, or finishing the article at a high heat, such as die forgings, will leave the metal in a state of crystallization or produce nests or streaks of coarse crystals, with a consequent weakening of the article at that place.
5. The manner of breaking may produce crystalline appearance of the fracture though the metal may be finely fibrous uniformly throughout its mass.
6. Iron and those classes of steel which are supposed to be capable of crystallizing under shock and vibrations will not break until long after the primary or original elastic limit and the yield point have been passed and the metal has flowed more or less.
7. The natural and inevitable consequence of "flow" in iron and steel is to break up and reduce the size of crystals and fibers; hence,
8. The forces which operate to break and destroy a structural member of whatever kind are directly antagonistic to the formation of crystals out of fibers, these forces being fiber producers, as it were, from the moment they become active until the point of rupture is reached. This tendency is increased as the point of rupture is approached, since flow is most rapid in iron and steel just before the metal breaks, as is proved by the reduction or contraction of area at the point of rupture. It is still further proved by the amorphous condition of "detail" fractures of iron and steel.
9. All of the foregoing goes to show that the theory of the crystallization of iron and steel under stresses and strains is based upon a misconception of the nature and properties of these metals, because low heat, or the heat that can possibly be produced in service, as well as stress and strain, with their analogous effects to mechanical work produced under hammer and roll, all tend to break up crystals in iron and steel, to make them smaller instead of making them larger or permitting the formation of a new structure.

TIE PLATE AND FASTENING FOR STEEL TIES.

While steel ties are extensively used in which the rails rest directly upon the ties, many engineers, particularly in Germany, prefer to use tie



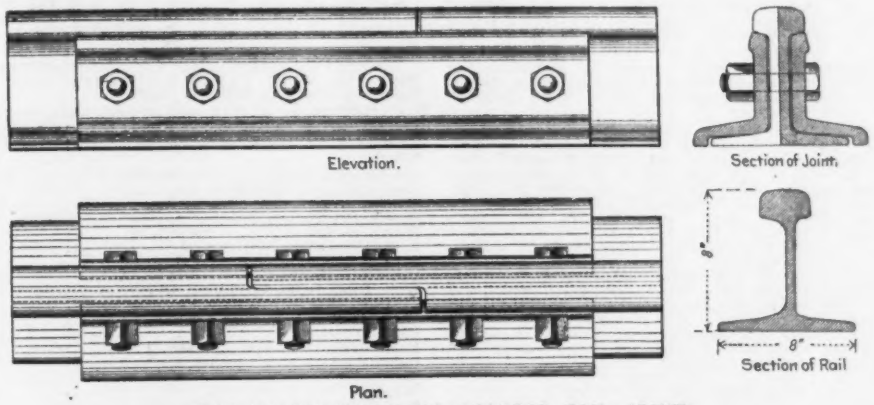
Tie-Plate and Fastening for Steel Ties.

plates between the rail and tie, and the accompanying cut shows the form designed by Mr. Haarmann, of Germany, and which is in use on about 365 miles of track. The plate has an inclined rail seat to give the inward inclination or cant of the rail, which is usual in European prac-

tice, to fit the conical tread of the wheels. The outer end of the plate has a lug on top to hold the outer side of the rail flange, and also a lug on the inner side, which takes hold of the tie. On the inner side is a slotted hole, into which the rail clamp fits, the clamp being secured by a T-headed bolt, as shown. As there is no bolt on the outside of the rail, the ballast may be filled in to the rail head if desired, thus getting additional resistance to lateral motion. On the German railways it is the practice to widen the gage on curves of over 6°, and with this construction of track the widening is effected by the use of four sizes of plates and clamps, giving eight different gages from 4 ft. 8½ ins. to 4 ft. 9¼ ins. An objection to this of course is the complication of parts, but this objection is not so great as it might seem at first, owing to the very much greater permanence of the parts and the great reduction in maintenance with the metal track.

THE HAARMANN-VIETOR SCARFED RAIL JOINT.

A form of rail joint which has been finding favor in Germany for the last few years is the scarf joint, in which the half of each rail is planed away for the length of the joint, the two halves lapping side by side and bolted together. This arrangement was shown in specimens of track exhibited at the Columbian Exposition last summer by Mr. Haarmann in connection with his splendid historical exhibit of track and track appliances, and attracted considerable attention. In the ordinary form the necessary thinness of the web and the lack of exact fit of the bolts detract from the theoretical usefulness of the joint, but Mr. Vietor, of Germany, who is associated with Mr. Haarmann, has invented a form of rail in which the head is not centrally over the web, so that only the side of the head need be planed off, leaving the web intact. The joints are spliced by angle bars, and with six bolts the four middle bolts pass through the splice bars and the two rail webs. This form of rail and joint are shown in the accompanying cut.



THE HAARMANN-VIETOR SCARFED RAIL JOINT.

The New York Rapid Transit Commission on July 17 formally adopted the plans and routes laid down for a system of rapid transit railways in tunnels by the old commission. It was also agreed to submit the question of the construction of such a system to popular vote, according to the statute, at the fall election. During the summer the engineering staff will prepare plans for a new route on the east side of the city. It is stated that the adoption of the old commission plans will not prevent any changes being made in them which the Commissioners may find advisable at a later date.

State construction and maintenance of highways in Massachusetts are provided for by an act of the legislature of that state, approved a few weeks ago. This may be done under the following conditions: The commissioners of a county, mayor and aldermen of a city, or selectmen of a town may petition the Massachusetts Highway Commission that the state take charge of an existing or construct a new road. The petition must be accompanied by a plan and profile of the road. If the commission decide that public necessity and convenience demand it they may grant the petition, provided that such roads shall be fairly apportioned among the different counties and not over ten miles of state road be constructed in any one county in a year, without the previous approval thereof in writing by the governor and council. Cities or towns in which it is proposed to construct state roads may, if they choose, take the contract for such construction at a price agreed upon between themselves and the highway commission, but if they do not so choose, then the commission must advertise the work and let contracts for it. One-fourth of any money expended under the provisions of the act in any county for a highway, with interest on the same at 6%, shall be repaid by the county to the state within six years, in such sums as the commission, with the approval of the state auditor, shall determine. County treasurers, with the approval of the county commissioners, may make such loans as they see fit to meet such expenditures. The law does not seem to make clear whether the provision, just cited, refers only to roads petitioned for by county commissioners, or to all roads for which petitions are submitted. The state is to issue bonds, not exceeding $300,000, to meet the expenses incurred under this act, and all the other expenses of the commission. Such bonds shall run not more than 30 years, and bear not more than 4% interest. This act is an amendment to the act of the legislature of 1893, creating the State Highway Commission, and is designed to make the construction of state roads easier than under the original law, as it removes some of the old restrictions and confers additional powers.

A Pennsylvania borough, it appears from a recent decision of the Supreme Court of that state, may build and operate water-works, although a private company is already supplying water within its limits and has a contract with the borough for fire hydrants. The decision just at hand was rendered in the case of certain taxpayers in the interest of the Bennett Water Co. against the Borough of Millvale. The Supreme Court denied the appeal from the decision given in the lower court against the company. Mr. Samuel Eades, of Bennett, is Burgess of Millvale.

The bullet-proof cuirass fever has struck American inventors. One, W. J. F. Leonard, of Brooklyn, N. Y., exhibited a shield of his invention to a company of reporters last week, and showed that it would successfully resist bullets from a repeating rifle of .45 calibre. Like the German tailor Dowe, Mr. Leonard proved his faith in his works by putting on the shield and permitting it to be fired at. Like him also he insists that there is no metal about his shield, but keeps its actual construction and material a profound secret, save to declare that it is made of a "combination of cotton, felt, wool and a compound of mineral and vegetable matter." The shield is said to be 13 × 17 ins. in area and 1¾ ins. thick, and to weigh 11 lbs. Another aspirant for fame in the same line is Ignatius Yucas, of Passaic, N. J. His shield is said to be a "secret material, held together by pasteboard" and to weigh only 20 oz. per sq. ft. when made 1 in. thick. The shield is said to have stopped a bullet from a .32 caliber Winchester and from the German Mannlicher rifle.

The reclamation of the Anacostia flats, in the District of Columbia, is recommended by the East Washington Citizens' Association. The association urges that an appropriation be made for the completion of the Anacostia River improvement, as contemplated in a report by Lieut.-Col. Hains, U. S. A.

The tubular-frame freight car is being extensively used in this and other countries, and it is reported that 7,500 of these cars are now in operation in the United States and 2,500 abroad. These have sills 10 ins. deep, composed of two 3-in. tubes united by clamps, but Mr. Dithridge, of the Iron Car Co., New York, has patented a sill of two tubes united by a web, all in one piece, the section resembling an I-beam with tubular flanges. In 1893 the Nitrate Railways, of Chile, operated 269 tubular-frame cars (250 built at Huntingdon, Pa., and 19 in England) and 936 ordinary cars, all on four-wheel trucks, and, with freight rates reduced 15%, the operating expenses were 35.45% of the gross earnings, while in 1889, with 1,000 of the ordinary cars the percentage was 46.59. The railway management is said to attribute the saving to the heavy loads carried and the small expense of repairs on the iron frame cars. In New South Wales, Mr. Eddy, Commissioner of Railways, has stated that by the use of these cars it is hoped to be able to reduce freight rates, and to assist in the development of the country. The cars have been described and the advantages of metal frames discussed at different times in our columns.

The best color for torpedo boats has been much discussed and experimented with. The French coast-guard ships are painted a lead color with a slight tinge of green, and that color was employed also on the Chilean torpedo boats "Lynch" and "Condell," which surprised and destroyed the armor-clad "Blanco Encalada," and on two occasions, at Iquique and Coquimbo, entered those ports at night, and were barely visible a few hundred feet away. The "Cushing" was at one time painted about that color, though, perhaps, a little darker. Another color commended for torpedo boats is a peculiar tint of brown. Germany, however, has, after many experiments, finally fixed upon bluish gray as least distinguishable under electric light, and has directed that all its coast-defenders and torpedo boats shall be painted that color. This choice is the more worthy of consideration since yellowish brown had previously been in favor in Germany. Coming again to our own experiments, the "Stiletto," when she tricked the searchlight at Newport, was dark green, and the color of the "Cushing" had been purposely deepened till it was nearly black. In recent experiments at Sandy Hook, the launch was not repainted, but, when she signalled to the searchlight to find her inside, her commander put tarpaulins painted a dark green over the sides of the craft.

Street sweeping in Milwaukee in June cost for 71,546,105 sq. ft. the sum of $4,134.59, or a little less than 6 cts. per 1,000 sq. ft.

Pig iron is being made by two companies in the Birmingham district of Alabama at a cost of $6.50 per ton of 2,300 lbs., according to a paper by Mr. E. C. Pechin, M. Am. Inst. M. E., in the "Engineering and Mining Journal." With a majority of the furnaces running, however, from 50 cts. to $1 per ton must be added to give the true cost, as the above figures include no royalty on coal or ore, the two companies which have attained this lowest figure owning and operating their own mines. The reduction in cost of $2 or more per ton which has taken place during the past four years is due apparently to improved processes and machinery, better management, and especially to the more careful mining and washing of the coal, producing a purer and better coke.

The reduction of dead load of freight cars has been specially aimed at in the new rolling stock designed by Mr. W. R. S. Jones for the Rajputana-Malwa Railway, of India (which is of meter gage), as shown in the following table:

Cars.	Dead load. Tons.	Capacity. Tons.	P. c. dead load to cap.
Four-wheel, open.....	3	9	33.3
" box.....	3	9	33.3
Eight-wheel open..	5	17	29.4
" box.....	6	18	33.3

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BUFFALO, ROCHESTER & PITTSBURG.—Press reports from Pittsburg, Pa., state that a new deal is in progress in connection with a proposed new trunk line railway system which is to enter Pittsburg. By the new plan three different railways running in three directions will be centered here. They are the Buffalo, Rochester & Pittsburg, the Beach Creek and the Pittsburg, Shenango & Lake Erie. The B., R. & P. is the new party to the deal. At present it has no way of reaching Pittsburg, except over the Allegheny Valley tracks from Dubois. The southern terminal of the line is Punxsutawney, where the Beach Creek line also terminates. From there it runs directly north to Buffalo and Rochester. By the construction of about 40 miles of track the two lines can reach Brady's Bend. From the present southern terminus of the Pittsburg, Shenango & Lake Erie road at Butler to Brady's Bend is only 30 miles, and by the extension of its line over the route already staked off the Pittsburg, Shenango & Lake Erie would join the other two lines. From Brady's Bend south to Pittsburg the new scheme provides for the joint construction of a double track line by the three companies, and it is stated that the plans for the line have progressed so rapidly that contracts for grading and construction will be awarded within the next 60 days. C. O. Billings, of Boston, and C. E. Gillette, of New York, are among those named as interested.

LEHIGH VALLEY.—McDonald & Sayre, Wilkes Barre, Pa., are building a second track on this line from Fairview, Pa., to L. & B. Junction, above Pittston, a distance of 20 miles.

OHIO SOUTHERN.—A press report states as follows: The extension of the Ohio Southern from Jeffersonville, O., to connect with the Pennsylvania, so as to give the company a line into Cincinnati, has been finished for about 15 miles from the former town. Jef-

fersonville is on the main line, south of Springfield, O., and the line extends from that town southwest to Port William, to which it is now finished, and thence to McKay's Station, five miles further, the terminus being at Oregonia, where it intersects the Little Miami.

PENNSYLVANIA MIDLAND.—The Baltimore "Sun" states that Philip W. Avirett, Hagerstown, Md., First Vice-Pres., Pennsylvania Midland, noted June 21, has paid in cash the last judgment and execution remaining against the old South Mountain R. R. and James March, Sr., the contractor, who owned the road, which was recently purchased by this company. Immediately upon payment of the judgment the deed from Mr. March to the new company was recorded and a mortgage to protect bondholders of the new road placed on file. A corps of engineers will at once be started from Lebanon to relocate the unfinished portion of the old line from Hamburg toward Harrisburg. The upper end of the line has been built. The Pennsylvania Midland Co. will endeavor to float enough bonds to build the lower branch and the Reading branch.

WASHINGTON & CHESAPEAKE BEACH.—The construction of this road has been resumed under the direction of the company, and it is again stated that the line will be completed this fall. The work was stopped last month, as stated in our issue of June 14.

Projects and Surveys.

AMSTERDAM, JOHNSTOWN & GLOVERSVILLE.—Incorporated in New York to build a standard gage steam railway from Akin, on the New York Central & Hudson River, to Gloversville, a distance of 11 miles; capital stock, $400,000; directors, David A. Wells, Lewis Veghte, James L. Northrup, Martin Kennedy, of Johnstown; Lawton Caton, James W. Green, Thomas G. Foster, John C. Allen, of Gloversville; Francis Morris, Willis Wendell, Cornelius Van Buren, of Amsterdam; J. D. Oliver, South Bend, Ind.; John H. McClement, of New York. The proposed road would parallel the Fonda, Johnstown & Gloversville, which is now controlled by the New York Central.

CANTON-AKRON.—Incorporated in Ohio to build a railway between Canton and Akron; capital stock, $50,000; incorporators, W. H. Hoover, L. E. Smith, W. H. Nees, G. C. Moyer and Milo White.

COLUMBIA & MARYLAND.—At a meeting at Laurel, Md., July 10, the following officers were elected: Pres., Stephen Gambrill; Secy., G. W. Waters, Sr.; Treas., Senator A. P. Gorman; Vice-Pres., Chas. H. Stanley. The question of constructing the proposed road will be considered at a future meeting. At the recent session of the Maryland legislature this company petitioned for authority to increase its capital stock to $10,000,000, and to build a steam or electric railway from Washington to Laurel, and thence to the Pennsylvania state line.

Southern—Existing Roads.

BALTIMORE & OHIO.—The Washington "Star" states that the people of Fairfax Court House have been authoritatively informed that the beginning of fall will see the resumption of work on the metropolitan extension of this road. The extension, when stopped, had reached a point close to Bethesda, running from Linden station, Md. Grading has been done some distance further on the line in the direction of the Chain bridge, near which it is proposed to cross the river, in order to secure the long-wanted southern connection through the old Manassas railway, a branch of the Richmond & Danville system. The entire right of way from Linden to the Chain bridge has been secured for this extension, through purchase, condemnation and gift, as has the greater part of the Virginia land needed. The road as laid out will cross the government reservation at the receiving reservoir, also the Conduit road, congressional permission having been already obtained.

CUYLER & WOODBURN.—This road is reported as about ready for tracklaying from Cuyler, Ga., on the Savannah & Western, to Woodburn, in Bullock county, a distance of 12 miles. Address J. N. Wood, Pineora, Ga.

LOGGING ROAD.—It is stated that Jesse Thompson & Co., Augusta, Ga., will extend their logging road from four to six miles.

Projects and Surveys.

STURGIS BELT LINE.—The surveys have been completed for this railway from Sturgis, Ky., on the Ohio Valley Ry., to Caseysville, on the Ohio River, and it is stated that the construction will soon be commenced. John H. Millin, Supt., Sturgis, Ky.

Southwest—Existing Roads.

GULF & INTERSTATE.—Press reports state that piling and bridge timber for building all the cutouts and waterways for the first 20 miles of this road from Bolivar, Tex., are now at Bolivar, and that the rails for this distance have been shipped. Grading is now in progress at Raywood, on the Southern Pacific, 56 miles north of Port Bolivar.

KANSAS CITY, ST. JOSEPH & COUNCIL BLUFFS.—L. J. Smith, Kansas City, Mo., is reported to have been awarded a contract for grading a 3¾-mile cutoff on this line at Winthrop Junciffon, Mo.

ROBELINE & SABINE PASS.—Surveys will soon be made for extending this railway 12 miles, according to reports. Supt., W. L. Gilmore, Victoria, Natchitoches Parish, La.

Projects and Surveys.

CORSICANA & SOUTHEASTERN.—It is stated that the rails have been purchased for building this projected railway from Buffalo, Tex., to a connection with the International & Great Northern, and that the construction will be commenced this month. The commercial club of Corsicana, Tex., is interested.

LOUISIANA.—Caldwell & Judak, Ashly, La., are reported to have awarded a contract for building and equipping seven miles of narrow gage railway to the Bunch & Yates Co., Memphis, Tenn.

Rocky Mt. and Pacific—Existing Roads.

FLORENCE & CRIPPLE CREEK.—Regular trains are now run from Denver to Cripple Creek, Colo., over the Denver & Rio Grande to Florence and thence over this road. The new road is 40.3 miles in length and was completed, including spurs and side tracks, July 11. The grading was started on the line Dec. 27, 1893, and was finished June 9; tracklaying was commenced about Feb. 15 and completed on the main line July 1. Ormon & Crook were the contractors.

MARICOPA & PHOENIX.—The city council of Phoenix, Ariz., is considering an ordinance granting this company a franchise for a dummy line in this city and to Mesa City. Gen. Man., C. S. Masten, Phoenix, Ariz.

Projects and Surveys.

UTAH.—Press reports state that Bishop Clawson, representing the Mormon Church; Mr. Trumb, an executor of the Stanford estate, and Col. J. S. Clarkson, are interested in a scheme for a railway to be built from Salt Lake City direct to Southern California, the construction to be commenced as soon as possible after the bill to admit Utah as a state has been signed by the President. Colonel Clarkson is reported as about to retire from politics to direct the financiering of the road. The press reports state also that the surveys and estimates for the road have been made and that there will be tangents in the route 60 and 70 miles in length. This new road is intended to furnish a coast outlet for the Rock Island, Burlington, Northwestern and Missouri Pacific systems.

Foreign.

MEXICO, CUERNAVACA & PACIFIC.—A press dispatch from Cuernavaca, Mex., states that the construction force on this road has been increased to 1,000 men and that the line is being pushed forward toward the port of Acapulco, on the Pacific Coast, as rapidly as possible. It is expected that the road will be completed to Cuernavaca by Feb. 1, 1895. The state of Morelia and the federal government have given the road liberal subsidies. The contractor and president of the company is J. H. Hampson, of Kansas City.

STREET AND ELECTRIC RAILWAYS.

RUTLAND, VT.—The Rutland St. R. R. Co. has petitioned the council for a franchise, under the name of the City Electric Co., to construct lines in three sections of the city. Capital stock, $100,000; Pres., E. A. Morse; Secy., James Carruthers; Treas., H. O. Edson.

NEW YORK, N. Y.—The New York & Philadelphia Traction Co. has been incorporated with a capital stock of $10,000,000. It is proposed to build an electric railway to be 150 miles long. Incorporators, Frank McGowan and J. P. Darrall, Trenton, N. J.; J. H. Reall, Bloomfield, N. J.

YONKERS, N. Y.—The North & South Electric Ry. Co. has been incorporated with a capital stock of $50,000 to construct a railway about five miles in length in this city. Directors, W. D. Baldwin, S. T. Hubbard, J. C. Shotts and T. H. Silkman.

KNOXVILLE, PA.—The council is discussing the question of granting a franchise for the construction of an electric railway from this place to Mt. Lebanon and Castle Shannon.

POTTSVILLE, PA.—A correspondent writes us as follows: The Car Equipment Co., Philadelphia, has purchased the controlling interest of the Schuylkill Electric Ry. Co. of this city, and it is its intention to extend the line about 25 miles, connecting St. Clair, Middleport, Tremont, Schuylkill Haven and other settlements with this place. Jesse Newlin and Robert Alliston have retired from the old board of directors and W. A. Barritt, Jr., and Charles H. Barritt, Pres. and Treas., respectively, of the Car Equipment Co., have been elected to fill these vacancies. J. B. Stuart, Philadelphia, who built the Pottstown, Camden and Gloucester roads, has been appointed electrician and general superintendent. The Schuylkill Electric Ry. proper consists of 10 miles of road, with an equipment of 18 cars, about half of which are new, the remainder consisting of Short apparatus, which will be no doubt replaced in the very near future with more modern equipment. New feeder wire will be put in on the entire system to supply sufficient and additional power for the extra car equipment that will be added and a new car barn will be built at Palo Alto. The entire system will be overhauled and will be put in a first-class condition as soon as possible.

SCRANTON, PA.—The Scranton North End St. Ry. Co. has been incorporated with a capital stock of $20,000; Pres., Lemuel Amerman.

WASHINGTON, D. C.—The commissioners have granted a franchise to the Eckington & Soldiers' Home R. R. to build an underground electric railway on North Capitol St. Vice-Pres. and Gen Man., W. K. Schoepf.

WESTMINSTER, MD.—The Baltimore Traction Co. has petitioned the council for a franchise to extend its electric line to this place.

DANVILLE, VA.—It is reported that the Danville St. Car Co. is contemplating extending its line to Neopolis.

CHIMNEY ROCK, N. C.—It is reported that an electric railway will be constructed from Rutherfordton to this place, a distance of 17 miles.

REDKEY, IND.—C. B. McCullough, Boston, representing a syndicate, has been granted a 25-year franchise to construct an electric railway to connect this place with Dunkirk. Work on the line will begin at once, according to press reports.

DETROIT, MICH.—Thomas Nevins, Orange, N. J., has purchased the street car lines for $8,250,000. There are 80 miles of tracks, 30 of which are already operated by electricity, and it is reported that the remaining 50 miles will be equipped at once with the trolley.

SAGINAW, MICH.—The Riverside Park Ry. Co. has been incorporated with a capital stock of $25,000, by J. M. Nicol, David Wallace, F. E. Snow, Detroit.

BELLEVILLE, ILL.—The council is considering the granting of a franchise to the St. Louis & Belleville Ry. Co. to extend their electric line.

CHICAGO, ILL.—The Central Rapid Transit Co. has petitioned for a franchise to extend its line on several streets and probably to Dunning and Norwood Park. It is proposed to use storage batteries. Capital stock, $1,500,000. Directors, W. W. Lowe, Omaha, Neb.; A. G. Goodman, H. C. Cornell, E. K. Grant and others.

DIXON, ILL.—The Electric Ry. Co. has been granted a franchise to construct a railway through the city. The line will be a part of the Rock River Electric Ry. from Rockford to this place, the right of way of which has already been secured.

PITTSBURG, KAN.—The Pittsburg, Frontenac & Suburban Electric Ry. Co. has been incorporated with a capital stock of $75,000 by Samuel Barrett, Robt. Robyn and A. L. Chaplin, Pittsburg; Robt. Simons, West Chester, Pa.

HIGHWAYS.

MASSACHUSETTS.—Hampshire county has been authorized to spend $24,000 this year, which will be used for building five short sections of road.

NEW YORK.—Bids are asked until July 31 for constructing 69,200 sq. yds. of macadam and excavating 22,000 cu. yds. in Richmond county, Staten Island. F. C. Vitt, Clk., Stapleton.

NEW JERSEY.—The freeholders of Burlington county have decided to raise $100,000 this year for stone roads, according to reports.

OHIO.—Bids are asked until Aug. 6 for macadamizing a road in Lucas county. C. H. Jones, County Audr., Toledo.

COLORADO.—It is proposed to build a road from Rangley, Colo., and Vernal, Utah, to Grand Junction, a distance of 110 miles. St. Vrain Lesieur and J. H. Calthrop, Rangley, are interested.

BRIDGES AND TUNNELS.

BARRINGTON, R. I.—Bids are asked until July 24 for the construction of an iron bridge and approaches over the Barrington River; length of bridge is 350 ft.; including approaches, 1,475 ft. Engr., Thos. Kieran, 22 Bedford St., Fall River, Mass. R. D. Horton, Chn. Com., 182 Dorrance St., Providence.

PROVIDENCE, R. I.—It is expected that the plans for the new Red bridge will be ready to be submitted to the council in about two weeks.

WESTFIELD, N. Y.—Engineers have reported that it would cost $6,000 to repair the bridge at Main St., and it is stated that the question of building a new $15,000 bridge will again be submitted to the voters.

PHILADELPHIA, PA.—Bids are asked until July 30 for constructing bridges. Jas. H. Windrim, Dir. Pub. Wks.

PITTSBURG, PA.—The Bellevernon Bridge Co. has been incorporated to build a bridge over the Monongahela River from Speersborough, Washington county, to Bellevernon, Fayette county; capital stock, $1,000; Treas., Geo. W. Theirs, Pittsburg.

SLATINGTON, PA.—Bids are asked until July 30 for a 77-ft. iron bridge over Trout Creek, with 14-ft. roadway. S. H. Schneck, Burgess.

SAVANNAH, GA.—Bids are asked until July 28 for rebuilding the bridges formerly connecting Skidway Island with the Isle of Hope. J. R. Dillon, Clk. County Comrs.

VICKSBURG, MISS.—Bids are asked until Aug. 6 for a 50-ft. bridge, with an 18-ft. roadway and a 6-ft. sidewalk. Edward McGinty, Supt.

CAMBRIDGE, O.—J. E. McClelland, Audr. Guernsey County, writes us that the following bids were received July 12 for a 160-ft. iron highway bridge over Wells Creek:

Buchanan Bridge Co., Bellefontaine, O.	$3,400
James Ritchie, Cleveland, O.	4,980
Canton Bridge Co., Canton, O.	3,335
Toledo Bridge Co., Toledo, O.	3,500
Massillon Bridge Co., Massillon, O.	3,800
E. B. Henderson, Marietta, O.	3,275
Groton Bridge & Mfg. Co., Groton, N. Y.	3,700
Champion Bridge Co., Wilmington, O.	3,075
King Bridge Co., Cleveland, O.	3,496
T. J. P. Brackett Bridge Co., Cincinnati, O.	3,600
H. A. Williams, Canton, O.	3,450
Chicago Bridge Co., Chicago, Ill.	3,497
Penn Bridge Co., Beaver Falls, Pa.	3,100
Indiana Bridge Co., Cincinnati, O.	3,100
Youngstown Bridge Co., Youngstown, O.	3,327
Wrought Iron Bridge Co., Canton, O.	2,950
Iron Substructure Co., Columbus, O.	3,260
Columbus Bridge Co., Columbus, O.	3,100
Nelson & Buchanan, Chambersburg, Pa.	3,290

HAMILTON, O.—Bids are asked until July 26 for the purchase of $100,000 of 4% county bridge bonds, and until July 30 for a 160-ft. iron and steel bridge across Gregory Creek, in Lemon township. Frank X. Duerr, Audr. Butler County.

TOLEDO, O.—The city clerk has been directed to advertise for bids for plans and specifications for an iron and steel bridge on St. Clair St., over Swan Creek. The bridge will be about 55 ft. long and will have a 36-ft. roadway and two 8-ft. walks; estimated cost, $25,000.

BRAZIL, IND.—A large wagon bridge over the Eel River in the southern part of this county was burned July 12, causing a loss of over $20,000, according to reports.

HAMMOND, IND.—A bridge on the Louisville, New Albany & Chicago Ry., near this city, was burned July 10.

JOLIET, ILL.—The county supervisors have voted to pay half of the expense of constructing the following bridges: Wilton township, across Forked Creek, $1,000; Jackson and Manhattan townships, two across Jackson Creek, $1,800; Will township, across Black Walnut Creek, $800. O. R. Rauchfuss, Cy. Engr.

STREATOR, ILL.—Bids are asked until July 23 for the construction of two stone arches across Coal Run, on South Bloomington St., city to furnish the stone. W. J. Zilm, Cy. Clk.

VALLEY JUNCTION, IA.—The county supervisors have contracted with the Toledo Bridge Co. for a highway bridge at this place, to consist of two 144-ft. spans, 16 ft. roadway, and to cost $9,000.

DULUTH, MINN.—A bill has been introduced in the House authorizing the Wisconsin & New Duluth Bridge Co. to construct a railway drawbridge over the St. Louis River, between New Duluth and the Wisconsin shore.

LANSING, MICH.—Bids are asked until July 25 for the erection of a steel bridge 210 ft. in length and 115½ ft. wide, two spans, arch girder. H. D. Bartholomew, Cy. Engr.

GLYNDON, MINN.—Press reports state that the Tenny bridge, on the Northern Pacific R. R., two miles west of this place, was burned July 11.

LEAVENWORTH, KAN.—Bids are asked until Aug. 6 for the construction of a bridge on Stafford road near Dwyer's farm and one over Poney Creek on De Hoff road. J. W. Niehaus, County Clk.

HOT SPRINGS, S. DAK.—A cloudburst near this place July 6 destroyed about 20 small bridges; loss about $10,000.

KALISPELL, MONT.—The city is reported as figuring on a $17,000 bridge.

ENID, OKLA.—A bridge on the Rock Island railway, a mile south of this place, was destroyed by dynamite July 13.

TRINIDAD, COLO.—A bridge 120-ft. long on the Aguilar branch of the Union Pacific, Denver & Gulf Ry. was burned by striking coal miners July 9, according to reports.

WATER-WORKS.

ASHLAND, N. H.—Frank Fifield, Chn. Comrs., writes us that the town is putting in a gravity system, estimated to cost $30,000. Engrs., Bartlett & Gay, Manchester.

CAMBRIDGE, MASS.—The mayor has recommended an additional appropriation of $17,500 for the department, including $13,500 for construction.

EASTHAMPTON, MASS.—The town has appropriated $6,000 for extensions.

IPSWICH, MASS.—McCusker Bros., Waltham, and Donato Cuozzo, 386 Broome St., New York, have 100 men and 25 teams at work on the storage reservoir of the new works, work to cost about $14,000 and to be completed Oct. 1.

MARLBORO, MASS.—B. R. Felton, Cy. Engr., writes us that the council has directed the commissioners to construct a high-service system for fire protection in the elevated part of the city. A stand-pipe 110 ft. high and about three miles of pipe will be required and another pump may be put in; estimated cost, $35,000.

MEDFORD, MASS.—The commissioners have recommended an appropriation of $25,000 for new mains and $50,000 for building storage basins at Wright's Pond.

NEW BEDFORD, MASS.—Geo. S. Rice and Geo. E. Evans, Boston, have reported in favor of an additional supply; the estimate including 54,000 ft. of 48-in. steel conduit, $437,000; two 5,000,000-gallon pumping engines, $25,000; one 10,000,000-gallon pumping engine, $50,000; total $710,000. The plan also included a system for the high-service districts at an additional cost of $85,100.

NEWBURYPORT, MASS.—The Newburyport Water Co. has voted to sell its plant to the city, which enjoins the city from constructing a separate plant.

NORTHAMPTON, MASS.—The city has purchased 2,200 tons of 24-in. pipe for the new main, and offers for laying it are being considered.

SALEM, MASS.—The board is considering the question of a new main in Essex St., estimated to cost $10,000.——The water board has decided in favor of building dam No. 3 in Longham meadow; estimated cost from $30,000 to $50,000, of which Beverly will pay one-third.

WORCESTER, MASS.—Extensions have been ordered in about 12 streets.

ANTWERP, N. Y.—There is talk of securing works. Five years ago it is stated that $10,000 was voted for this purpose, but the estimated cost at that time was in excess of this amount and the question was dropped.

BUFFALO, N. Y.—The board of public works has recommended the laying of 36 and 16-in. mains, at an estimated cost of $96,000. L. H. Knapp, Ch. Engr. Water Bureau.

HAMILTON, N. Y.—Surveys are being made for a gravity system. B. J. Stetnson, Village Clk.

MANLIUS, N. Y.—Bids are asked until Aug. 2 for constructing works. Engr., E. G. Smalley, Syracuse.

NEWTOWN, N. Y.—The Citizens' Water Co. is about to extend its mains through the villages of Maspeth, Corona, Middle Village, East Williamsburg and Laurel Hill, according to reports.

PINE HILL, N. Y.—J. A. Longyear, of the recently incorporated Highmount Water Co., writes us that the works are nearly completed; supply from spring.

RHINEBECK, N. Y.—J. R. Thompson, Amenia, is arranging with the council for a franchise for a proposed Rhinebeck Water Co. J. C. McCalky, Clk.

SEA CLIFF, N. Y.—The village has contracted with the Sea Cliff Camp Ground Association for a supply and for 25 hydrants for five years.

SYLVAN BEACH, N. Y.—The Sylvan Spring Water Co., of Oneida, has been incorporated by Morton Cavana, E. G. Gay, J. F. Cody and others; capital stock, $35,000. Works are being constructed.

WASHINGTONVILLE, N. Y.—A few years ago the Washingtonville Water-Works Co. was incorporated with a capital stock of $20,000, but the $400 asked by the company for 25 fire hydrants was not secured and no works were built. Wm. H. Cowan, Montgomery, president of the company, is reported to have now arranged with the village to put in works; supply from Silver Stream, about two miles distant.

HOBOKEN, N. J.—Bids are asked by the water commissioners until Aug. 7 for 75 tons of 6-in. cast iron pipe. Henry Lohmann, Jr., Water Registrar.

RIVERSIDE, N. J.—The Riverside Water Co. has contracted for a 12 × 120-ft. stand-pipe and 5½ miles of pipe, according to reports.

BEAVER FALLS, PA.—A contract for sinking test wells was recently awarded to Simon Harrold and a daily supply of over 1,000,000 gallons is reported to have been secured. There is talk of the city building works.

DOWNINGTON, PA.—Thos. Halliday, Secy. Council, writes us that several plans and sources of supply are being considered, but no definite steps will be taken until after the election this week.

McDONALD, PA.—Robt. J. Cook, Clk., writes us that the city has contracted with the Citizens' Water Co. for 40 fire hydrants at $1,000 per year. Bids for constructing the works were advertised last week, bids to close July 18.

MIFFLINBURG, PA.—The council stands 3 to 3 against works, but it is stated that nearly all of the representative citizens have signed a petition for a contract with the Mifflinburg Water Co. for works.

NORTHUMBERLAND, PA.—Edgar Holt, Vice-Pres., writes us that the Northumberland Water Co. has awarded the contract for works to A. M. Thomas, Lock Haven. The bids were private.

RANKIN, PA.—Bids will probably be asked soon for about five miles of pipe and other work, estimated to cost $20,000. W. H. Gordon, Clk.

REYNOLDSVILLE, PA.—There is talk of putting in works at West Reynoldsville; supply from creek; estimated cost, $10,000.

WAPWALLOPEN, PA.—The Mountain Springs Water Co. was incorporated July 13; capital stock, $3,000; Treas., Frank E. Everard.

ABERDEEN, MD.—It is stated that a company has been organized to put in works; supply from Swan Creek, two miles distant; estimated cost, $12,000 to $15,000; Pres., Dr. J. H. Kennedy; Secy., J. A. Swingerly. Engr., C. M. Johnson, Baltimore.

BERRYVILLE, VA.—The plant of the Berryville Water Co. has been purchased by Marshall McCormick, representing the bondholders. About $17,000 has been spent on the works, and as much more will be required to complete the plant, according to reports.

WHEELING, W. VA.—Concerning the item noted last week, Hoge & White, Cy. Engrs., write us as follows: Altenheim is a home for old women, and is a charitable institution about two miles east of the city. There is a small water-works plant there, which supplies the home with water and also several suburbs nearby. Leatherwood is one of these suburbs, and the people at Leatherwood want the system extended and more fire hydrants put in. They have taken steps to organize a volunteer fire company. The total cost will be small. For further information address S. I. Singleton, Wheeling Title & Trust Co.

APALACHICOLA, FLA.—The editor of the "Times" states that he is negotiating with Philadelphia parties to put in works in this place.

QUINCY, FLA.—The Quincy Water-Works Co. has been incorporated with a capital stock of $10,000.

SELMA, ALA.—The water company is reported as about to double the capacity of its plant.

PHOENIX CITY, ALA.—The Columbus Water-Works Co., Columbus, Ga., has petitioned for a franchise to extend its works across the Chattanooche River to this place. W. L. Booth, Cy. Clk.

BILOXI, MISS.—It is reported that new works will be built. The present plant was constructed in 1889 by the Biloxi Artesian Water-Works Co. under a 25-year francise, which does not provide for purchase of works by the city.

SHELBYVILLE, KY.—Bids are asked until July 20 for constructing works and an electric light plant. H. P. Poynter, Secy., Shelbyville Water & Light Co.

BELLEVUE, O.—The city has sold $12,000 in water-works bonds for $12,245.

BUCYRUS, O.—H. L. Weber, Cy. Engr., writes us that the following propositions will be submitted to the voters: To contract with the Bucyrus Water Co. for a supply; to buy out the company; or to build new works; population of the city, 8,000.

CLEVELAND, O.—Bids are asked by the park commissioners until July 25 for about 124 tons of 36-in. pipe. Engr., C. W. Pratt, Jr., 717 Hickox Bldg.

GLENDALE, O.—Bids are asked until Aug. 16 for the purchase of $6,000 in 5% water extension bonds. B. D. Bartlett, Clk.

HILLSBORO, O.—Bids are asked until Aug. 15 for the purchase of $10,000 in water-works bonds. L. Ambrose, Village Clk.

MOUNT STERLING, O.—The proposed issue of bonds for works and electric lights was defeated, the vote being 136 for and 96 against the issue.

NORWOOD, O.—An election will be held July 25 to vote on an issue of $50,000 in bonds for water-works purposes.

ST. BERNARD, O.—Reports state that the following lowest bids have been received: Foundations, Michael Stopper, Cincinnati, $3,357; water tower, L. Schreiber & Sons, Cincinnati, $6,189; pipelaying, R. U. Andrews, Hamilton, $5,544.

UPPER SANDUSKY, O.—The power house of the water-works plant was destroyed by fire July 10, causing a loss of $20,000, according to reports.

UTICA, O.—It is stated that the construction of works seems assured; plans include reservoir.

WAPAKONETA, O.—The citizens have voted against the proposed granting of a franchise.

WINTON PLACE, O.—The village has petitioned for a supply from the Cincinnati mains.

NEW HAVEN, IND.—Bids will be opened about Aug. 1 for constructing works; supply from wells. Engrs., Wickenden & Clark, Toledo, O. D.E. Callaghan, Town Clk.

CROSSWELL, MICH.—It is stated that the question of issuing bonds for $9,000 for works will soon be voted upon.

ONTONAGON, MICH.—Bids are asked until July 24 for constructing works, including 18,000 ft. of 10 to 4-in. pipe, 40 hydrants, water tower and pumping plant; supply from artesian wells; population, 2,200. Engr., Chas. F. Loweth, St. Paul. J. H. Comstock, Pres. Bd.

SAGINAW, MICH.—The city has sold $10,000 in 4% water bonds for $10,880.

ALTON, ILL.—The council has voted to withhold payments due the Alton Water-Works Co. until a new filter has been put in at the pumping crib.

BLOOMINGTON, ILL.—The contract for laying 1,437 ft. of 20-in. main has been awarded to G. McIntosh, at $4,100. R. Loudon bid $5,100.

CHICAGO, ILL.—The council finance committee is reported as about to ask for authority to advertise for bids for two new 12,000,000-gallon and four new 15,000,000-gallon pumping engines, for the construction of 6,000 ft. of intake tunnel and about 15 miles of new mains, at an estimated cost of $1,200,000.

DE KALB, ILL.—E. A. Porter, Cy. Clk., writes us that specifications will soon be ready and bids will then be asked for proposed extensions, noted last week; supply from artesian well. Engr., Daniel W. Mead, Rockford, Ill.

GALVA, ILL.—Bids are asked until July 26 for pumping machinery, pipe and other materials for works. W. M. Hill, Cy. Clk.

JOLIET, ILL.—The council has passed an ordinance for laying 17,000 ft. of 6-in. mains in various streets. O. R. Rauchfuss, Cy. Engr.

MORRIS, ILL.—Bids are asked until Aug. 1 for constructing works, as stated in our advertising columns. Henry C. Claypool, Cy. Clk.

ROSSVILLE, ILL.—The citizens are reported as discussing the question of works.

LA CROSSE, WIS.—Frank C. Powell, Cy. Engr., writes us that the city may purchase a 10,000,000-gallon pump in the near future; present supply from Mississippi River; supply from tube well system is proposed.

TOMAHAWK, WIS.—Bids are asked until July 25 for 1¼ miles of 6 and 8-in. extensions, 6 or 8 hydrants, etc. Chas. A. Ayer, Cy. Clk.

WAUWATOSA, WIS.—The county board has engaged J. A. B. Thompkins to make surveys and estimates for the proposed extension of the Milwaukee mains to the county buildings at this place.

BLUE EARTH CITY, MINN.—C. N. Brown, Recdr., writes us that the village voted July 3 to raise $15,000 for extensions, for which specifications will be ready about July 20; supply from artesian well.

MARSHALL, MINN.—Bids are asked until July 31 for constructing a combined water-works and electric light plant, including steel tower and wooden tank, brick power house, steam plant, artesian well, etc. C. F. Case, Village Pres.

MINNEAPOLIS, MINN.—The board of trade committee on health has voted in favor of artesian wells as a source of city water supply.

NORTHFIELD, MINN.—Bids are asked until July 20 for the purchase of $40,000 in 20-year 5% water bonds, and until July 27 for constructing works. M. W. Skinner, Chn. Com.

ESTHERVILLE, IA.—N. B. Egbert, Cy. Clk., writes us that the city has engaged P. C. Barney to make plans and superintend the construction of works and an electric light plant.

JEFFERSON, IA.—M. E. Hall, Cy. Clk., writes us that the following bids were received for the complete construction of works:

*U. S. Wind Engine & Pump Co, Batavia, Ill.	$12,302
**J. S. Black, 422 Bee Bldg., Omaha, Neb.	11,873
Iowa Construction Co., Sioux City, Ia.	12,774
Newman, Wright & Schreiner, Des Moines, Ia.	14,147
Youngstown Bridge Co., 400 Main St., Keokuk, Ia.	15,519

* Without pump, $11,438.
** Awarded contract at $11,280, without pump.

OTTUMWA, IA.—A bill for the appointment of a receiver for the Iowa Water Co. and the foreclosure of a mortgage for $400,000 has been filed at Keokuk by the Farmers' Loan & Trust Co., New York, according to press reports.

HARVARD, NEB.—Bids are asked until Aug. 6 for constructing works and also for the purchase of $7,500 in water-works bonds. Engr., A. A. Richardson, Lincoln.

HUMPHREY, NEB.—Bids are asked until Aug. 13 for constructing works and for the purchase of bonds voted for this purpose. Engr., A. A. Richardson, Lincoln.

WILBER, NEB.—The following bids were received July 5 for works:

*Pomerene & Cooper, Lincoln, Neb., complete.	$17,578
E. A. Rudiger, Nebraska City, Neb., complete.	19,127
Fremont Foundry & Mach. Co., Fremont, Neb., complete	18,954
Harmon & McDonald, Omaha, without pump and stand-pipe	11,821

* Awarded contract.

WESSINGTON SPRINGS, S. DAK.—B. B. Blosser, Clk., writes us that works will not be put in this year.

BETHANY, MO.—Bids are asked until July 20 for constructing works, including a 500,000-gallon pumping engine, 12 × 100-ft. stand-pipe, two 16 ft. × 60-in. boilers, four miles of 8 to 2-in. pipe, etc. Engr., Austin A. Cassill, Bethany. W. S. Wightman, Cy. Clk.

GAINESVILLE TEX.—Owing to a failure to agree upon a new contract, the supply was turned off July 10 and the council has voted to advertise for bids for new works. Address Mayor Shortridge.

OAK CLIFF, TEX.—The council has voted to issue $10,000 in 50-year 6% bonds for improving the works. The works have been leased to a company for 20 years and the company will also invest $10,000 in improvements, which will include an artesian well, water-tower, etc.

ROCK SPRINGS, TEX.—We are informed that J. M. Haney, owner of the works, proposes to extend the plant.

SEATTLE, WASH.—The Seattle Power Co. has been incorporated to operate and maintain water-works, reservoirs, etc.; capital stock, $500,000; incorporators, E. H. Ammidown, T. A. Noble and Maurice McMicken.

AZUSA, CAL.—James T. Taylor has been engaged by the Azusa Irrigation Co. to make surveys and specifications for a pressure system of works for domestic and irrigation purposes for some 4,000 acres in the Azusa Valley, Los Angeles county. Bonds have been issued to cover the cost and the construction will be commenced as soon as plans have been adopted.

COLTON, CAL.—An election was held July 3 to vote on an issue of $60,000 in bonds for the purchase and extension of works.

EUREKA, CAL.—James T. Keleher, Cy. Clk., writes us that there is a prospect that the city will vote on issuing bonds for works.

PASADENA, CAL.—The Lake Vineyard Water Co. is reported as about to take steps to secure an increased supply.

OTTAWA EAST, ONT.—A stock company is being formed to put in works, according to reports. F. A. Hibbard, Engr.

PORT HOPE, ONT.—The council has passed an ordinance appropriating $30,000 for improving and extending the present works, which are for fire protection only.

TORONTO, ONT.—The board of works has voted to appropriate $20,000 for surveys for a proposed gravity supply from Lake Simcoe.

HONOLULU, HAWAIIAN ISLANDS.—Bids are asked until Sept. 1 for pipe and pumping plant, as stated in our advertising columns. Specifications may be seen at office of E. H. Allen, Consul-General, Hawaiian Islands, 51 Leonard St., New York.

ARTESIAN WELLS.

MARSHALL, MINN.—Bids are asked until July 31 for boring an artesian well. C. F. Case, Pres. Village.

GAINESVILLE, TEX.—Bids are asked until July 24 for boring an artesian well. W. S. Smith, Chn. Com.

ROCKY FORD, COLO.—R. S. Beall, Cy. Clk., writes us that a committee is securing the necessary funds for sinking a well 1,000 ft. deep.

IRRIGATION.

GRANT, NEB.—The county voted July 12 on a proposition to issue $90,000 in bonds to the Perkins County Equitable Irrigation & Power Co., to aid in the construction of an irrigation canal to extend from Julesburg, Colo., through Perkins county. It will be about 65 miles in length. It is believed that the bonds will be voted and it is expected that work on the ditch will be commenced before Sept. 1.

NEW COMPANIES.—Ramshorn Ditch Co., Ford Precinct in Scott's Bluff county, Neb.; $12,500; Carroll Nichols, Yorick Nichols, John T. Logan, Joseph Ralls and Peter Vanburg.——Montgomery County Irrigating Co., Independence, Mo.; $2,000; C. H. Woetz, W. M. Wade, A. C. Stich, Henry Baden aand J. W. Simpson.

SEWERS.

CARIBOU, ME.—E. W. Hall, Clk., writes us concerning the item noted last week that no work will be done this year.

LACONIA, N. H.—Bids are asked until July 30 for the purchase of $126,000 of 4% sewerage bonds.

GREENFIELD, MASS.—At a town meeting July 9 it was voted to appropriate $12,000 for building a system, only Greenfield labor to be employed.

NATICK, MASS.—At a town meeting it was voted to construct a system at a cost of $150,000. A committee, consisting of Riley Pebbles, E. S. Dodge, Edward Clark and others, has been appointed to superintend the work, and only Natick labor will be employed.

SOUTH HADLEY, MASS.—The selectmen have accepted a plan prepared by Engineer Kirkpatrick, Holyoke, to lower the trunk sewer on Bridge St. 10 ft.; estimated cost, about $22,000. A town meeting will probably be called to vote on the question.

WORCESTER, MASS.—The council has adopted ordinances for constructing 750 ft. of 30 × 24-in. and 1,050 ft. of 27 × 18-in. brick sewers in three streets; estimated cost about $5,000; and 12 to 10-in. pipe sewers in four streets; estimated cost, $2,866.

PAWTUCKET, R. I.—The council has adopted ordinances for constructing sewers in five streets; estimated cost, $8,750.

BROOKLYN, CONN.—The commissioners of Windham county are discussing plans for a sewage disposal plant.

AVON, N. Y.—S. D. Backus, Canandaigua, has prepared plans for a system of pipe sewers to be about five miles long; estimated cost, about $11,000.

BROOKLYN, N. Y.—Bids are asked until July 26 for constructing sewers in two streets. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until July 25 for constructing 45-in. to 27-in. brick and 12-in. pipe sewers in Dingens St. R. G. Parsons, Secy., Dept. Pub. Wks. ——The commissioners of public works have received the following bids for constructing two sewers:

	Cambridge Ave.	Pleasant Ave.
J. C. Green	$4,890	$9,264
Henry Harter	4,354	9,178
Christopher Smith	4,500	8,402
W. A. Rappich	4,204	9,614
W. A. Cookman	3,969	....
Jacob Ritzman	3,914	7,624
August Gisel	3,440	8,200
Harrer & Hess	4,000	9,458
Jones & Sullivan	4,574	8,678
John Mumm	4,048	7,724
J. Maguire	4,620	8,118
Frank Cobb	4,026	8,945

FAR ROCKAWAY, N. Y.—The construction of a system is being discussed.

HUNTINGTON, N. Y.—Property owners on New York Ave. are reported as about to petition the board of health to improve the system in that vicinity.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements of wards 23 and 24, 2622 Third Ave., until July 26 for constructing sewers in three streets.

POUGHKEEPSIE, N. Y.—Bids are asked until July 24 for constructing about 2,000 ft. of 24 to 12-in. pipe sewers, as stated in our advertising columns. C. E. Fowler, Supt. Water Bd.

PLAINFIELD, N. J.—We are informed that the contracts for constructing the proposed system, noted last week, will be awarded for the completed sewer measured in the trench, the contractors to furnish all materials. The surveys for the entire system are completed, and preliminary profiles already prepared. Completed plans and specifications will be ready by the end of this month. J. W. McMurray, Cy. Clk.

CHARLEROI, PA.—C. P. Speers, Burgess, writes us that the following bids have been received by the council for constructing four sewers:

Geo. F. Egan, Pittsburg	$17,219
Standard Constructing Co., Pittsburg	12,461
W. H. Roberts, Pittsburg	10,436
Bowman Bros., McKeesport	9,410
John Sweeney, Pittsburg	9,269
P. O. Donnell, "	8,923
Peter Braun, "	8,857
E. A. Freshwater, Homestead	7,787
Andrew Hahn, Pittsburg	7,757
Williams & Kennedy, Pittsburg	7,419
H. H. Penny, Charleroi (awarded contract)	7,103

PHILADELPHIA, PA.—Bids are asked until July 30 for building main and branch sewers. J. H. Windrim, Dir. Pub. Wks.

PITTSTON, PA.—Plans have been completed by Potter & Folwell, Pittsburg, for a system to be about 24 miles long; estimated cost, $108,373. The sewer in Main St. will be of brick and the rest will be of pipe.

SWARTHMORE, PA.—J. W. Landis, Secy., writes us that an election will be held July 25 to vote whether to give the council authority to borrow $16,000 for sewers and streets. Until then no steps will be taken to secure plans.

WASHINGTON, D. C.—Bids are asked by the district commissioners until July 28 for constructing sewers.

HUNTSVILLE, ALA.—E. R. Matthews, Clk., writes us that the plans made by S. M. Gray, Providence, R. I., have been accepted, and it is probable that work will begin this fall; bids for the works have not yet been advertised for. The city is authorized to spend only $10,000 a year for sewers.

CLEVELAND, O.—Bids are asked until July 25 for constructing a sewer in Murray Hill Ave. J. H. Farley, Dir. of Pub. Wks.——The council has adopted ordinances for constructing sewers in five streets. H. H. Burgess, Cy. Clk.

HAMILTON, O.—The commission has recommended that contracts for constructing sewers be awarded to Wilson, Strach & Kinch, Cincinnati, at $29,908 and $10,971, and McCarty & Segers, Cleveland, at $17,043.

MARIETTA, O.—Bonds for $15,000 are to be sold for constructing a system in the second district, for which bids will probably soon be asked. J. W. Van Metre, Chn. Comn.

RIVERSIDE, O.—Bids are asked until Aug. 15 for the purchase of $10,000 of 5% sewerage and street improvement bonds. G. H. Gaffey, Village Clk.

SANDUSKY, O.—Bids are asked until Aug. 11 for constructing sewers in two streets. A. W. Miller, Cy. Clk.

TOLEDO, O.—The city clerk has been directed to advertise for plans to extend the sewer district.——The council has adopted ordinances for constructing cylindrical brick sewers in three streets. L. P. Harris, Cy. Clk.

INDIANAPOLIS, IND.—The contract for constructing a main sewer in East St. has been awarded to Gansberg & Roney at $2.14 per ft. The other bids being as follows: Acme Paving & Const'n Co., $2.15; W. C. Allen & Co., $2.17; A. Bruner, $2.25; Fulmer-Seibert Co., $2.60.

GRAND RAPIDS, MICH.—It is proposed to construct a trunk sewer to drain the Coldbrook Creek, estimated to cost between $40,000 and $50,000, with $10,000 additional for laterals.

URBANA, ILL.—Bids for the construction of 15,410 ft. of 12 to 8-in. pipe sewers are asked until July 26, a postponement of date from July 18, as noted in our issue of July 5. C. B. Holmes, Cy. Clk.

MILWAUKEE, WIS.—The board of public works has awarded the following contracts for constructing pipe sewers: V. Oergott, $1.17 per ft.; G. E. Zimmerman, $1.03, $1.00; August Kruger, $1.08½; William Goff, $1.00; R. J. Wilson, $1.14.

RIPON, WIS.—C. B. Dickinson, Cy. Clk., writes us that surveys have been made, and that plans are being prepared by W. F. Goodhue, Milwaukee, for a system.

DES MOINES, IA.—The contract for constructing a sewer in Capital Park has been awarded to Kavanaugh & O'Connell at $49,170. The bids were published in our issue of July 5.

ST. LOUIS, MO.—A committee has been appointed from among the property owners of the northwestern portion of the city to urge the board of health to have a sewer at once constructed along Harlem Creek.

WESTPORT, MO.—F. T. Robertson, Cy. Engr., in a report, estimates the cost of a system of 56,000 ft. of 10 to 6-in. pipe sewers at $46,238, and for an outlet sewer for Hyde Park and adjacent districts of 8,120 ft. of 15 to 12-in. pipe sewers at $11,076.

SAN ANTONIO, TEX.—The plans made by S. M. Gray, Providence, R. I., for the proposed system have been completed. The system will consist of about 75 miles of main sewers and is estimated to cost $378,980.

DENVER, COL.—The board of aldermen has adopted an ordinance appropriating $40,000 to construct a portion of the $150,000 Delgany St. sewer extension by day labor, but if the results are not satisfactory it will be completed by contract.

SALT LAKE CITY, UTAH.—The city engineer estimates the cost for the construction of a sewer to connect the Fort Douglass sewers with those of this place at about $32,000, and it is probable that the government will authorize the construction.

TORONTO, ONT.—The mayor in an address has recommended the construction of a main sewer 7½ miles long, estimated to cost $865,000, or, if constructed a mile further, would cost about $1,000,000.

STREETS.

NASHUA, N. H.—The committee has voted to ask the council for an appropriation of $17,000 for paving.

HOLYOKE, MASS.—The council has authorized an issue of $140,000 in bonds for street improvements.

PAWTUCKET, R. I.—The council has adopted ordinances for improving five streets; estimated cost, $8,350.

PROVIDENCE, R. I.—Bids are asked until July 21 for 7,582 sq. yds. of asphalt paving in Pine St. R. E. Smith, Comr.

MERIDEN, CONN.—The committee will readvertise for bids for paving with stone. About 70,000 blocks will be used; estimated cost, about $10,000.

BUFFALO, N. Y.—The contract for repaving Connecticut St. with Trinidad asphalt has been awarded to the German Rock Asphalt & Cement Paving Co., at $34,566.——The following bids have been received for paving Ontario St. with Trinidad Lake asphalt:

Barber Asphalt Paving Co.	$73,338
German Rock Asphalt & Cement Co.	75,076
P. B. McNaughton (brick)	54,345

HEMPSTEAD, N. Y.—An election will be held Aug. 6 to vote on an appropriation of $150,000 for macadamizing streets.

NEW YORK, N. Y.—Bids are asked by the department of public works until July 25 for paving 145th St. with granite blocks on concrete; 130th St. with granite blocks, and 151st St. with asphalt on concrete. ——The park board has received the following bids for furnishing rock asphalt for Central Park sidewalks: H. G. Homer, Brooklyn, $21,675; Sicilian Asphalt Co., $23,175; Compagnie Generale des Asphaltes de France, $23,387. The bids were all rejected July 18 and the work will be readvertised.

ROCHESTER, N. Y.—The park commissioners are having surveys made for an extensive boulevard, for which the estimates will probably be ready by July 30. ——The council has adopted ordinances for improving Exchange St., estimated cost $10,500, and for paving several streets with brick, asphalt and macadam.

NEW CASTLE, PA.—Bids are asked until July 23 for grading and paving portions of four streets. Frank Tidball, Cy. Clk.

PHILADELPHIA, PA.—The Rutherford Land Co., of Cape May, was incorporated at Trenton, N. J., July 16, to grade and build streets and roads, construct sewers, etc.; capital stock (all paid in), $25,000; incorporators, David H. McKinley, Robt. G. McLaughlin and Theodore M. Beger.——The director of public works has been authorized to readvertise for bids for a large amount of brick paving.

LAUREL, MD.—The citizens are reported to have voted to issue $30,000 in 5% bonds for paving.

COVINGTON, KY.—Bids are asked until July 23 for 9,678 sq. yds. of brick paving, 4,200 ft. of curbing, 1,590 cu. yds. concrete, etc. T. H. Kennedy, Cy. Engr.

CINCINNATI, O.—Bids are asked by the board of administration until July 26 for paving one street with brick, and until Aug. 7 for paving Eighth St. with granite blocks, and Elder St. with brick.——The Ohio Bermudez Asphalt Co. was incorporated July 14, with a capital stock of $100,000, by B. H. Moewer, W. C. Pierce, J. D. DeWitt, B. F. Hamm and Edward Hart.

LIMA, O.—Bids are asked until Aug. 9 for 12,635 sq. yds. of brick paving. The bids received for this work were published last week, but were rejected. R. H. Gamble, Cy. Engr.——Bonds for $30,000 for street paving have been sold to Deitz, Dennison & Pryor, Cleveland, at a premium of $1,200.

MARION, O.—Bids are asked until Aug. 6 for improving two streets. James Williams, Cy. Clk.

LANSING, MICH.—The council has decided to pave Washington Ave. with brick, estimated to cost $19,500.

DANVILLE, ILL.—Bids are asked until Aug. 9 for stone curbing in 13 streets. R. E. Lloyd, Cy. Clk.

STREATOR, ILL.—Bids are asked until July 23 for improving 5,227 lin. ft. of streets. W. J. Zilm, Cy. Clk.

RACINE, WIS.—The city treasurer has sold $50,000 of paving and improvement bonds.

HOUSTON, TEX.—Bids are asked until Aug. 6 for grading and paving nine streets with asphalt, brick, stone or macadam. J. T. Browne, Mayor.

DENVER, COLO.—The board of public works received the following bids July 2 for paving East Larimer St. with asphalt: F. O. Blake, $91,218; J. A. W. Pine, $104,969; Bermudez Asphalt Paving Co., $115,610; Barber Asphalt Paving Co., $115,818; Blake Co., $117,900. The itemized bids received last month for this work were published under Contract Prices June 28.

HAMILTON, ONT.—The council has adopted specifications for paving King and James Sts. with asphalt and curbing with stone. The city engineer estimates the cost at $2.80 per sq. yd. for asphalt, or $150,000 for the entire work.

WINNIPEG, MAN.—The city engineer is preparing to carry out plans for granite, macadam and gravel paving, estimated to cost about $40,000. It is probable that bids will soon be asked for the work.

ELECTRIC LIGHT AND POWER.

FONDA, N. Y.—The citizens have voted to have the streets lighted by electricity.

GAITHERSBURG, MD.—The council has decided to advertise for bids for electric street lighting for one year, according to reports.

RED KEY, IND.—It is reported that a proposition has been submitted to build an electric light plant.

SOUTH HAVEN, MICH.—The council is discussing the question of granting a franchise for an electric light plant.

VICKSBURG, MICH.—The question of putting in an electric light plant is being discussed.

ARCADIA, WIS.—The council has decided to have the streets lighted by electricity.

IOWA FALLS, IA.—The council is reported as about to grant a franchise to put in an electric light plant.

ALBERT LEA, MINN.—The power house of the electric light company was destroyed by fire July 4; loss, $8,000. It is reported that the plant will be rebuilt at once. C. G. Edwards is the manager.

MARSHALL, MINN.—Bids are asked until July 31 for constructing a combined electric light and waterworks plant. E. T. Matthews, Recdr.

BETHANY, MO.—Bids are asked until July 20 for constructing an electric light plant. Engr., A. A. Cassil. W. S. Wightman, Cy. Clk.

SUMMERSIDE, P. E. I.—Bids are asked until Aug. 15 for putting in an electric light plant.

MONTREAL, QUE.—Bids are asked until Aug. 1 for building a dam across the Richelieu River turbines for 500 HP., and furnishing wire, electrical machinery, etc., for transmitting 15,000 HP. from Chambly to this city. C. B. Gaudet, Secy. Chambly Mfg. Co., New York Life Bldg., Montreal.

NEW COMPANIES.—The Eldridge Electrical Mfg. Co., Eldridge, N. Y.; $10,000; W. C. Ranney, L. B. Doman, A. E. Doman.——Stanstead Electric Light Co., Stanstead, Que.; $25,000; Henry Lovell, M. B. Lovell, C. A. Lovell, Coaticook; M. F. Hackett, J. M. Le Moyne, A. N. Thompson, Stanstead Plain; Geo F. Terrill, Sherbrooke.——Emmons Electric Co., Chicago, Ill.; $50,000.——Oswegatchie Light & Power Co., Gouverneur, N. Y.; $60,000; to furnish light for Gouverneur, Edwards, Fowler, and other towns in St. Lawrence county; H. W. Webb, A. G. Paine, New York; W. J. Arkell, Canajoharie; A. L. McCrea, Jr., A. J. McDonald, Gouverneur.——Keyser Electric Light Co., Keyser, W. Va.; $50,000; F. M. Reynolds, J. M. Templeton, A. W. Caffroth.——Brooklyn Gas & Electric Co., Brooklyn, N. Y.; $10,000; C. W. Schluchtner, E. A. Fitts, W. J. Winberg.——Great Kanawha Falls Water Power, Electrical Mfg. & Land Co., W. Va.; $2,000,000; to utilize the Great Kanawha Falls to generate electricity, etc.; O. A. Patton, W. D. Scott, M. Levi, Charleston; C. M. Reeder, Baltimore, Md.; A. McClintock, Lexington, Ky.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

CITY HALL.—Rome, N. Y.—Bids are asked until July 23 for constructing a city hall. K. S. Putnam, Cy. Chamberlain.

PIER WORK.—New York, N. Y.—Bids are asked by the police department until July 25 for alterations and additions on Pier A.

GAS COMPRESSORS.—Findlay, O.—Bids are asked by the natural gas department for furnishing two 30 × 30-in. compressors. C. A. Stockton, Pres. Dept.

JAIL.—Joliet, Ill.—The board of county supervisors has appropriated $12,000 to remodel the sheriff's residence and make a jail of the same. O. R. Rauchfuss, Cy. Engr.

FIRE ALARM SYSTEM—New Brunswick, N. J.—Bids are asked by the council until July 27 for a fire alarm system, all bidders to make a public test of their systems before the fire committee on July 25.

DREDGING AND CEMENT.—New York, N. Y.—Bids are asked by the department of docks until July 31 for 200,000 cu. yds. of dredging in the North River; also for furnishing about 5,000 bbls of quick setting and 3,000 bbls. of slow setting Portland cement.

ELECTROZONE PLANT.—New York, N. Y.—Bids are asked until July 26 for furnishing a plant at Riker's Island for the manufacture and distribution of electrozone (sodium hypochlorite), with a capacity of 4,000 gallons per hour. Wm. S. Andrews, Comr. of St. Cleaning.

IRON AND STEEL WORK—Washington, D. C.—The Brown-Ketcham Iron Works, Indianapolis, has been awarded the contract for the steel and iron columns in 1st, 2d, 3d, 4th and 5th stories and constructing steel and iron work in 3d, 4th, 5th and 6th floors in the U. S. public building in this city, at $59,533.

BUILDINGS—Columbus, O.—Bids are asked until Aug. 9 for the erection, except foundations, of the following buildings for the state hospital, located near Massillon: One dining-room building, one kitchen and bakery building, one store house, one laundry, one power house, one machinery building, one boiler and coal house. Yost & Packard, Archs.

DRAINAGE WORK—Sumas, B. C.—Bids are asked until Aug. 2 for the construction of levee embankments and minor works connected therewith; diversion and straightening of certain sloughs; closing of Sumas River by an earthwork dam; construction of a rock tunnel through a spur of Sumas mountain; furnishing and erecting of gates at said tunnel. Engrs., Keefer & Smith, Victoria, B. C. G. W. Chadsey, Clk. Sumas Diking Comrs.

BONDS—Ironton, O.—Bids are asked until Aug. 1 for the purchase of $60,000 in 5% cemetery bonds. Wm. A. Murdock, Chn. Com.

Pawtucket, R. I.—Bids are asked until July 21 for the purchase of $600,000 in 4% bonds; being $300,000 for widening and opening streets, $175,000 of sewer loan, $125,000 of water-works account loan. Frank M. Bates, Cy. Treas.

DAMS—Alberton, Md.—Press reports state that the dam at this place, which supplies water power for the manufacturing plant of James S. Gary & Son has again sprung a leak. The dam has only been erected three years, but has cost several thousand dollars already for repairs.

Lenox, Mass.—W. H. Maguire, West Newton, is reported to have been awarded a contract, without competition, for building a dam 35 ft. high at this place.

LEVEE WORK—Delta, La.—Bids are asked until July 30 for enlarging and raising the following levees:

	Cu. yds.
Milliken's Bend to Nebraska, about	65,000
Buckhorn, about	15,000
Willow Slough, about	75,000
Towne, about	11,000
Bruin Bayou, about	17,000
Marshall, about	12,000
Approximate total cubic yards	195,000

W. H. Shields, Secy., Comrs. Fifth La. Levee Dist.

Donaldson, La.—Bids are asked until Aug. 6 for constructing six levees. L. D. Martin, Secy., Comrs. Lafourche Basin Levee District.

FIRE ENGINES AND WATER TOWERS.—St. Joseph, Mo.—The following bids were received by the council July 10: American Fire Engine Co., Jones engine, 2d size, $3,800; Ahrens engine, 2d size, $3,900; Manchester Locomotive Wks., Manchester, N. H., Amoskeag engine, 2d size, $3,850; La France Fire Engine Co., La France engine, 2d size, $4,200; Hale Harness & Fire Supply Co., Kansas City, 55 -ft. Hale water tower, $3,850; Chicago Fire Extinguisher Mfg. Co., 65-ft. Champion tower, $4,675; 55-ft. Champion tower, $4,500; 55-ft. Hale tower, $4,500.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
July 20.	Water-works system, Coxsackie, N. Y.		July 5
	Advertised, Eng. News, July 5, 12.		
July 20.	Water-works, Shelbyville, Ky.		July 19
July 20.	Electric light plant, Shelbyville, Ky.		July 19
July 20.	Water-works bonds, Northfield, Minn.		July 19
July 20.	Electric light plant, Bethany, Mo.		July 19
July 20.	Water-works system, Bethany, Mo.		July 19
July 21.	Paving bonds ($200,000), Cincinnati, O.		June 28
July 21.	Brick paving, Cincinnati, O.		June 28
July 21.	Water-works bonds, Napoleon, O.		July 5
July 21.	Granite blocks, Central Falls, R. I.		July 12
	Advertised, Eng. News, July 12.		
July 21.	Road improvements, Cincinnati, O.		July 12
July 21.	Bonds ($600,000), Pawtucket, R. I.		July 19
July 21.	Asphalt paving, Providence, R. I.		July 19
July 23.	Paving, Montgomery, Ala.		July 5
July 23.	Sewers, South Bend, Ind.		July 12
July 23.	City hall, Rome, N. Y.		July 19
July 23.	Paving, New Castle, Pa.		July 19
July 23.	Brick paving, Covington, Ky.		July 19
July 23.	Stone arches, Streator, Ill.		July 19
July 23.	Street improvements, Streator, Ill.		July 19
July 24.	Water-works, Napoleon, O.		June 28
	Advertised, Eng. News, June 28 and July 5.		
July 24.	Electric light plant, Napoleon, O.		June 28
	Advertised, Eng. News, June 28 and July 5.		
July 24.	Dredging, etc., Block Island, R. I.		July 12
	Advertised, Eng. News, July 12 and 19.		
July 24.	Bridge, Barrington, R. I.		July 19
July 24.	Pipe sewers, Poughkeepsie, N. Y.		July 19
	Advertised Eng. News, July 19.		
July 24.	Water-works system, Ontonagon, Mich.		July 19
July 24.	Artesian well, Gainesville, Tex.		July 19
July 25.	Ironwork, etc., Washington, D. C.		July 5
	Advertised, Eng. News, July 5 and 12.		
July 25.	Pier work, New York, N. Y.		July 19
July 25.	Bridge, Lansing, Mich.		July 19
July 25.	W.-wks. extensions, Tomahawk, Wis.		July 19
July 25.	Brick sewers, Buffalo, N. Y.		July 19
July 25.	Asphalt paving, New York, N. Y.		July 19
July 25.	Cast iron pipe (36-in.), Cleveland, O.		July 19
July 25.	Sewers, Cleveland, O.		July 19
July 26.	Water-works system, New Haven, Ind.		July 5
July 26.	Cast iron pipe, etc., Westfield, N. Y.		July 12
July 26.	Pipe Sewers, Charlottesville, Va.		July 12
	Advertised, Eng. News, July 12 and 19.		
July 26.	Brick paving, Muscatine, Ia.		July 12
July 26.	Sewers, Brooklyn, N. Y.		July 19
July 26.	Electrozone plant, New York, N. Y.		July 19
July 26.	Sewers, New York, N. Y.		July 19
July 26.	Brick paving, Cincinnati, O.		July 19
July 26.	Bridge bonds ($100,000), Hamilton, O.		July 19
July 26.	Water-works materials, Galva, Ill.		July 19
July 26.	Pipe sewers (15,410 ft.), Urbana, Ill.		July 19
July 27.	Sewer, Cincinnati, O.		July 12
July 27.	Water-works system, Northfield, Minn.		July 12
	Advertised, Eng. News, July 12.		
July 27.	Fire alarm syst'm, New Brunswick, N.J.		July 19
July 28.	Power-house and bldg., Detroit, Mich.		June 28
	Advertised, Eng. News, June 28 to July 12.		
July 28.	Sewers, Washington, D. C.		July 19
July 28.	Bridge, Savannah, Ga.		July 19
July 30.	Street improvement bonds, Ashland, O.		July 5
July 30.	Street improvement bonds, Norwood, O.		July 5
July 30.	Highway, Toledo, O.		July 5
July 30.	Asphalt pav'g (29,700 sq.yds.), Dayton, O.		July 12
July 30.	Water-works bonds, Marshall, Minn.		July 12
July 30.	Bridges, Philadelphia, Pa.		July 19
July 30.	Sewer bonds ($126,000), Laconia, N. H.		July 19
July 30.	Sewers, Philadelphia, Pa.		July 19
July 30.	Bridge (77-ft.), Slatington, Pa.		July 19
July 30.	Levee work, Delta, La.		July 19
July 30.	Bridge (160-ft.), Hamilton, O.		July 19
July 31.	Bridge, New Westminster, B. C.		June 21
July 31.	Rock removal, Newport, R. I.		July 12
	Advertised, Eng. News, July 5 to 26.		
July 31.	Sewer, Cincinnati, O.		July 12
July 31.	Street improvements, Avondale, O.		July 12
July 31.	Plumbing, etc., Washington, D. C.		July 12
	Advertised, Eng. News, July 12 and 19.		
July 31.	Cement, New York, N. Y.		July 19
July 31.	Dredging, New York, N. Y.		July 19
July 31.	Macadamizing, Stapleton, N. Y.		July 19
July 31.	Artesian well, Marshall, Minn.		July 19
July 31.	Water-works system, Marshall, Minn.		July 19
July 31.	Electric light plant, Marshall, Minn.		July 19
Aug. 1.	Sewer bonds ($100,000), Victoria, B. C.		June 28
Aug. 1.	Water-works system, Carey, O.		July 5
	Advertised, Eng. News, July 5 and 12.		
Aug. 1.	Bonds, Ironton, O.		July 19
Aug. 1.	Water-works system, Morris, Ill.		July 19
	Advertised, Eng. News, July 19 and 26.		
Aug. 1.	Dam, etc., Montreal, Que.		July 19
Aug. 2.	Dredging steamer, Wilmington, N. C.		July 12
Aug. 2.	Water-works system, Manlius, N. Y.		July 19
Aug. 2.	Drainage work, Sumas, B. C.		July 19
Aug. 3.	Bridge, Red Wing, Minn.		July 12
	Advertised, Eng. News, June 21 and 28.		
Aug. 4.	Street improvements, Mansfield, O.		July 12
Aug. 6.	Electric lighting, Rome, N. Y.		June 14
Aug. 6.	Bridge (50-ft.), Vicksburg, Miss.		July 19
Aug. 6.	Levee work, Donaldsonville, La.		July 19
Aug. 6.	Street improvements, Marion, O.		July 19
Aug. 6.	Macadamizing, Toledo, O.		July 19
Aug. 6.	Bridges, Leavenworth, Kan.		July 19
Aug. 6.	Water-works and bonds, Harvard, Neb.		July 19
Aug. 6.	Asphalt or brick paving, Houston, Tex.		July 19
Aug. 7.	Cast iron pipe, Hoboken, N. J.		July 19
Aug. 7.	Granite paving, Cincinnati, O.		July 19
Aug. 8.	Bridge, Cleveland, O.		July 12
Aug. 9.	Buildings, Columbus, O.		July 19
Aug. 9.	Brick paving (12,635 sq. yds.), Lima, O.		July 19
Aug. 9.	Stone curbing (13 Sts.), Danville, Ill.		July 19
Aug. 11.	Sewers, Sandusky, O.		July 19
Aug. 13.	W.-wks. and bonds, Humphrey, Neb.		July 19
Aug. 15.	Architectural competition, Atlanta, Ga.		July 12
Aug. 15.	Water-works bonds, Hillsboro, O.		July 19
Aug. 15.	Sewer bonds ($10,000), Riverside, O.		July 19
Aug. 15.	Electric l't plant, Summerside, P. E. I.		July 19
Aug. 16.	Water-works bonds, Glendale, O.		July 19
Aug. 22.	Drainage canal, Chicago, Ill.		June 28
	Advertised, Eng. News, June 28 to Aug. 14.		
Sept. 1.	Electric lighting, Portland, Ore.		June 21
Sept. 1.	Pumping plant, etc., Honolulu, H. I.		July 19
	Advertised, Eng. News, July 19 and 26.		
Sept. 3.	Bridge, Dillon, Mont.		July 5
No date.	Gas compressors, Findlay, O.		July 19
"	" Brick paving, Lansing, Mich.		July 12
"	" Sewers (20,814 ft.), Le Mars, Ia.		July 12

CONTRACT PRICES.

PIPE AND LEAD.—Vancouver, B. C.—The contract for pipe and lead, recently advertised, has been awarded to the British Columbia Iron Wks., Vancouver, at $38 per ton for cast iron pipe, $45 for flexible joints; $80 for specials, and $67.20 for lead.

TANK AND STAND-PIPES.—New York, N. Y.—The contract for a receiving tank 8 ft. in diameter and 47 ft. high and a stand-pipe 6 ft. in diameter and 138 ft. high at the high-service works at new aqueduct, and a 20-in. stand-pipe and a 12-in. waste pipe in tower at High Bridge have been awarded to M. J. Drummond, at $11,900; the only bid received for the work. The prices were as follows:

Cast iron work,	80,000 lbs.,	per lb.	$.04½
Steel work,	112,000 "	"	.05
Wrought iron work,	3,000 "	"	.05
Brass work,	1,000 "	"	.40
Lead work	5,000 "	"	.07
Rock excavation,	30 cu. yds.,	per cu. yd.	.60.00

FILLING.—Boston, Mass.—The park commissioners have received the following bids for 200,000 cu. yds. of filling at Marine Park, South Boston: W. L. Miller, 47 cts. per cu. yd.; Seth Perkins, Agent, 47 cts.; Eastern Dredging Co., 47⅞ cts.; Boynton Bros., 55 cts.; New England Dredging Co., 54 cts.; Jones & Meehan, 58 cts.; Columbia Dredging Co., 60 cts.

STEAM ROAD ROLLER.—Cincinnati, O.—J. P. Gerstle, Asst. Clk., Bd. of Administration, writes us that the following bids were received for furnishing a 25,000-lb. steam road roller, front rolls not less than 4 ft. in diameter and rear rolls not less than 6 ft. in diameter, with face not less than 22 ins. wide; roller to be equipped with double-speed gear, single engine and with water tank capacity sufficient to operate roller for at least five hours' consecutive work, etc.: R. C. Pope Agent, Chicago, Aveling & Porter roller, English make, second-hand, f. o. b cars in Cincinnati, $1,800; Tobin & Hamler Mfg. Co., Chicago, roller as per specifications, with steam steering gear, $3,000 when completed in this city; The O. S. Kelly Co., Springfield, O., roller complete with a guarantee for one year, $2,097 (awarded contract).

ARCH WORK.—New York, N. Y.—The following bids were received July 10 for alteration to the arch conveying the Croton aqueduct across Nepperhan Ave. in the city of Yonkers, the total bids being (1) Brendlinger & Nearing, $18,700 (awarded contract); (2) W. M. Myers, $22,300; (3) Dougherty & Berrigan, $26,000; (4) Steward & McDermott, $33,650:

		1.	2.	3.	4.
Excavation,	9,000 cu. yds., at	$.60	$.40	$.75	$1.00
Filling,	2,000 " "	.25	.05	.30	.50
Cutstone mas.,	50 " "	40.00	38.00	30.00	55.00
Stone	" 2,000 " "	2.00	4.00	4.75	4.75
Brick	" 500 " "	8.00	12.00	8.00	14.00
Concrete	" 250 " "	4.00	6.00	5.00	8.00
D'y st'n wall,	1200 " "	1.50	1.00	2.50	2.00

SEWERS.—Greensburg, Pa.—The following bids have been received for constructing sewers in Ward 5:

	Pipe sewer, per lin. ft.			Manholes, each.
	12-in.	10-in.	8-in.	
Bennett & Talbot	$.47	$.43	$.38	$25.00
Frank McConegly	.38	.35	.32	20.00
James White	.48	.43	.39	16.50
Daniel Bennett	.40	.35	.31	19.00
Wilson, Smith & Coon.	.67	.63	.58	20.50
Geo. W. Good	.41	.39	.37	9.00

Portsmouth, Va.—W. T. Brooke, Consult. Engr., Norfolk, informs us that the following bids were received June 23 for constructing the proposed sewerage system, recently advertised in Engineering News; total bids were published in our issue of July 5:

Bids Received at Portsmouth, Va., for Constructing Sewerage System.

Bidders.	Pipe. 18-in. 5,833 lin.ft.	12-in. 555 lin.ft.	10-in. 830 lin.ft.	8-in 73,590 lin.ft.	4-in. house br'nchs 50,000 lin.ft.	18-in.c.i. outl'ts, 650 lin.ft.	Automat- ic flush tanks, 124.	Manholes complete 109.	Inspection pipes, 19.	Total.
Graham & Riddle, Norfolk, Va.	$1.95	$1.63	$1.63	$1.52	$.20	$3.34	$70.00	$45.00	$12.00	$151,529
B. I. Coyle, Washington, D. C.	1.30	1.24	...	.94	.24	4.70	67.00	28.00	35.00	104,526
Rutherford & Brown, New York	1.29	.99½	.95	.72	* ..	5.50	50.00	38.00	30.00	76,337
Gabory, Noble & Wadleigh, Macon, Ga.	1.22	.82	.67	.52	.15	5.81	68.00	30.00	15.00	68,358
Delany, Bryning & McCawly, St. Joseph, Mo.	1.09	.62	.52	.42	.21	7.00	78.00	30.00	18.00	66,375
McGuire & McKnight, Cleveland, O.	.90	.79	.71	.47	.17	3.05	50.00	28.00	15.00	60,884
Sandford & Brooks, Baltimore, Md.	.69	.51	...	.32½	.17	3.00	33.00	43.00	13.00	47,701
D. Lee Wardrope & Co., Macon, Ga.	.66	.55	.42	.31	15½	2.71	50.00	26.35	13.70	46,151

* Already included.

EXCAVATION, ETC.—Boston, Mass.—the superintendent of streets has received the following bids for the excavating, screening and removing of material from Commonwealth Ave. (north side), by blocks—No. 1 block extending from Arlington to Clarendon Sts.; No. 2, Clarendon to Exeter Sts.; No. 3, from Exeter to Gloucester Sts.; No. 4, from Gloucester St. to Massachusetts Ave.; excavation is made preparatory to asphalting the whole avenue: Neil McBride, $1.60 per cu. yd. for each block; Frank H. Cowin, 85 cts., 84 cts., 83 cts. and 80 cts. per cu. yd. for the four blocks, respectively; Jeremiah J. Sullivan, 99 cts., 97 cts., 95 cts and 92 cts.; B. F. O'Connor, 99 cts., 97 cts., 95 cts. and 90 cts.; Doherty & O'Leary, 95 cts., 95 cts., 87 cts. and 80 cts.; William Scollans, $1.34, $1.29, $1.24 and $1.19. The contract was awarded to F. H. Cowin for block 1; J. J. Sullivan for block 2; B. F. O'Connor for block 3; Doherty & O'Leary for block 4.

STONE.—Newport, R. I.—Capt. W. H. Bixby, U. S. Engineer Office, writes us that the following bids were received July 17 for about $8,000 worth of stone work at Stonington breakwater, Conn:

	Per ton.
Daniel Toomey, Guilford, Conn.	$0.98
S. & E. S. Belden, Hartford, Conn.	1.03
George W. Andrews, Biddeford, Me.	1.15
John Salter & Son, Groton, Conn.	1.25
W. H. Molthrop & Co., New London, Conn.	1.13

The contract will probably be awarded to Daniel Toomey.

ASPHALT PAVING.—Milwaukee, Wis.—The contracts for paving nine blocks with asphalt have been awarded to the Western Paving & Supply Co., at $2.09 per sq. yd. for four blocks and $2.23 for the five blocks in Grand Ave.; stone curbing, 50 cts. per lin. ft.; resetting curbing, 8 cts. The Western Bermuda Co. bid $2.23 on the Grand Ave paving, but was a little higher than the successful bid on curbing. The other bidders were the U. S. Asphalt Co., Warren-Scharf Asphalt Paving Co., Wm. Forrestal and Jos. Markey.

Jersey City, N. J.—Two bids were received for paving Bowers St. with asphalt, one from the (1) Sicilian Asphalt Paving Co., New York, and the other from the (2) Barber Asphalt Paving Co., the prices being as follows:

	1.	2.
Earth excavation, per cu. yd.	$.30	$.20
Rock " "	4.50	2.00
New curbstone, per lin. ft.	.55	.52
Repaving, per sq. yd.	.49	.45
Resetting curb, per lin. ft.	.10	.05
Relaying bridge stone, per lin. ft.	.08	.05
Asphalt paving, per sq. yd.	2.77	2.69

New York, N. Y.—The following bids were received July 10 for paving 40th and 63d Sts. with asphalt upon the present stone block pavement, the total bids being (1) Sicilian Asphalt Paving Co., $25,258 (awarded

contract); (2) Barber Asphalt Paving Co., $26,240; (3) Warren-Scharf Asphalt Paving Co., $25,692:

		1.	2.	3.
Paving,	6,850 sq. yds., at..	$3.59	$3.73	$3.65
Bridge stone,	205 sq. ft., " ..	.50	.50	.50
Curbstone,	1,175 lin. ft., " ..	.48	.50	.50

BRICK PAVING.—Bellaire, O.—John A. Gow, Cy. Clk., writes us that a contract for 1,100 sq. yds. of street paving with home brick, hard fireburned, with garvel and sand foundation, has been awarded to John Davis at 61 cts. per sq. yd. Thomas Rosser bid 63½ cts. for the work, and the other bids ranged from that to 78 cts. per sq. yd. A press report states that similar work two years ago cost $1.46½ per sq. yd.

Sandy Hill, N. Y.—The council has accepted an offer of Floor & Sherrill, local contractors, to pave Main St. with two courses of brick, a local brick for the bottom layer and then a layer of Hornellsville hard brick, at $1.68 per sq. yd., the village to do the excavating.

STONE PAVING.—New York, N. Y.—The following bids were received July 10 for 2,388 sq. yds. of paving with granite blocks in 107th St., from Amsterdam Ave. to the Boulevard:

	Paving, per sq. yd.	Bridge stone, per sq. ft.
Reilley & Mahony	$2.20	$.60
F. V. Smith	2.62	.50
P. H. McCullagh (aw'd contract)	2.20	.43
James A. Gearty	2.25	.50

METAL MARKET PRICES.

LEAD.—New York: 3.5 to 3.55 cts. Chicago: 3.15 to 3.2 cts. St. Louis: 3.1 to 3.15 cts.

NAILS.—Pittsburg: $1.15 for wire, and 95 cts. for cut at mill, in carload lots.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13. Pittsburg: $10.75 to $12. Chicago: $9.50 to $11.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.1 to 2.15 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tide water; old rails, $11.00 for iron, and $10.00 for steel; steel rails fit for relaying, $16.00 to $16.50; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $10.50 for iron and $6.50 to $9.00 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.4 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.45 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.2 to 1.35 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.4 cts. for shell, 1.45 cts. for flange, 2½ to 3 cts. for ordinary firebox, and 3.35 to 3.4 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.45 cts.; tees, 1.65 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.55 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

INDUSTRIAL NOTES.

CAR WHEELS.—A company has been organized at Philadelphia to manufacture steel car wheels under the patents of James A. Facer, of Germantown, Pa.

CARS.—The Buffalo Car Co., of Buffalo, N. Y., and the Lebanon Mfg. Co., of Lebanon, Pa., have each an order for 1,000 coal cars for the Lehigh Valley R. R.

THE WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., has an order for 16 motors for the Worcester & Millbury Electric Ry. Co., of Worcester, Mass.

ASPHALT PLANT.—The Litho-Carbon Rubber Co., composed of New York and San Antonio, Tex., capitalists, is working its asphalt mines in Uvalde Co., near San Antonio, and has erected a large plant for refining the material and manufacturing asphalt varnishes, etc.

THE CONTINENTAL PALACE CAR CO., of East St. Louis, Ill., is to be organized with a capital stock of $5,000,000, and it is said that the capital will be raised in England. With the echoes of the Pullman troubles in their ears, English investors are not likely to look with much favor on new aspirants for the palace car business.

THE PETELER PORTABLE RY. CO., of Minneapolis, Minn., has brought out a new style of dump car. It is built with a steel frame, dumps on one side only and is specially adapted for use with steam shovels, having no posts at the corners to be bumped. The doors of these cars are hung on independent posts which extend down to the truck. When the car is dumped the door is thus kept elevated, allowing plenty of room for the load to pass beneath, no matter how large the pieces may be. The company makes a specialty of small cars for tunnels, quarries, coal docks, and 2,000 of its dump cars are in use on the Chicago drainage canal, for which work also 100 of the new style cars have been purchased by McArthur Bros.

THE RICE & SARGENT ENGINE CO., of Providence, R. I., whose organization was recently noted in our columns, is prepared to build all sizes of engines, simple and compound, for all kinds of service. Its specialty is a four-valve automatic cut-off engine, with double-ported Corliss rotary valves. The bed plate is of box section with bored guides. Separate eccentrics operate the steam and exhaust valves, and the engine is controlled by a high speed governor of the Porter type. The company has an order for a 250-HP. cross-compound engine, with cylinders 14 × 36 ins. and 26 × 36 ins. for the electric lighting plant at Marblehead, Mass. Mr. Rice was for four years mechanical engineer and superintendent of the W. A. Harris Steam Engine Co., and Mr. Sargent has been mechanical engineer for the Dixon Mfg. Co. and the Providence Steam Engine Co. The engines are to be built by the Builders' Iron Foundry, of Providence, which fact is in itself a good guarantee as to their workmanship.

NEW COMPANIES.—Eastern Contracting & Dredging Co., New York; $5,000, commencing with $500; Geo. W. Ballou, 10 Wall St.; Charles C. Dodge, New York, and W. Pond, Brooklyn, N. Y.——Downing & Lawrence Dry Dock Co., Brooklyn, N. Y.; $100,000; Merrick D. Lawrence, Edward Downing and Charles K. Buckley.——United Dock Co., Duluth, Minn.; $50,000; J. D. Stryker, F. A. Gooding and George P. Wilson.——McMyler Car Dumping Machine Co., Cleveland, O.; $100,000; John McMyler, C. A. Judson and James Pickards.——Bellevernon Bridge Co., Pittsburg, Pa.; $1,000 with $100 paid up; to build a bridge over the Monongahela; Treas., Geo. W. Theis.——United States Electrical Forging Co., New York, N. Y.; $1,000,000, with $000 paid in; Edwin Garsia, 45 Beaver St., and G. S. Allison, 31 Broadway.——McGinniss Smith Co., Pittsburg, Pa.; $100,000, with $10,000 paid in; pipe and heating apparatus; Treas., McGinniss Smith.——Johnson Mining Machine Co., Chicago, Ill.; $500,000; James T. Johnson and Jesse L. Moss.——Hartwell & Co., New York; $25,000; railway building; Horace E. Hartwell and Howard A. Stevens.——Otto Gas Engine Works, Philadelphia, Pa.; $400,000, with $40,000 paid in; Treas., Frederick Bledan.——Clamond Telephone Co., Philadelphia, Pa.; $300,000, with $30,000 paid in; J. Andrews Harris, Jr., Chestnut Hill, Philadelphia.——Fitzsimmons Telephone Co., Cincinnati, O.; P. Fitzsimmons, Covington, Ky.; R. N. Archer, and James Pettibone, Cincinnati.

MUNICIPAL BOND MARKET.

New York, July 17, 1894.

The feature of the municipal bond market for the financial week ending to-day has been the fiasco attending the offering by the city of Chicago of the $3,000,000 4% drainage bonds spoken of in these columns last week. These bonds are of date July 1, 1894, and their average life is 10 years. It was announced before the sale that no bid at less than par and accrued interest would be considered. Only two bids were received and both were rejected. The Illinois Trust and Savings Bank, of Chicago, offered to take the entire issue at par less a commission of $180,000, provided the bonds were made payable in gold. The other bidder was James Swan, who bid 100½ for a block of $25,000. It had been reported that a syndicate of Western banks had made arrangements to take a large block of the bonds, but no evidence of this was presented, nor were there any indications manifest of a desire on the part of Eastern investors to put their money in these bonds. Western bond dealers explain the lack of bidders by reason of the high upset price put on the bonds. The previous issue of these bonds bearing 5% interest sold at 101.79, or on a 4¾% basis. Applying this basis to the 4% bonds of the present issue, the price would be fixed at a fraction less than 94, the average life of both issues being 10½ years. A 4% bond at par would make the relative value of the 5% security 108, and even Chicago dealers admit that anything like this price for a Chicago city bond is out of the question.

Eastern bond experts, who are not so interested in preserving Chicago's credit, see in this incident how thoroughly shaken has been investors' belief in the security attaching to Chicago bonds. It was pointed out in these columns how the affiliation of the Chicago municipal and Illinois state authorities with the lawless element of the population would not redound to their advantage, and the harm done to the city's credit by the "masterful inactivity," to use a mild and charitable phrase, is fully reflected in the unwillingness of investors both in the East and West to confide their money in the Chicago municipal government. Not but that the bonds in question are really good, but the demonstration of the inefficiency of Chicago's authorities in suppressing lawlessness and riotous demonstrations has not been of a character to encourage investments in Chicago.

Another lesson may also be adduced from the Chicago experience. Bonds selling at less than par, no matter what the surrounding circumstances, are seldom regarded with much favor by investors, the disposition being to take those issues on which there is a premium, even though the net returns are considerably lower. An issue of bonds on a 5 per cent. basis is, therefore, almost always surer of a larger number of bidders than an issue of bonds bearing interest at the rate of 4 per cent. per annum.

The demoralization of all financial and commercial circles consequent upon the railroad strike curtailed to a large extent the demand for municipal bonds generally in full blast at this period of the financial year. But there is none the less a goodly amount of business doing, brokers still eagerly picking up various issues in anticipation of a largely revived retail demand at an early date. As an instance of the sharp competition among bond dealers for high grade issues, the offering of $100,000 Starke county, O., 5 per cent. bonds brought out 19 bidders. Among them were N. W. Harris & Co., of New York and Chicago, who, with an experience as to values born of thousands of similar transactions, put in what they considered a top price. When the bids were opened, it was found that nine other bids were higher than that of Harris & Co. The bonds were awarded to a local bank on a 4¼ per cent. basis.

As to what the future of the municipal bond market offers, it is interesting reading to quote what ex-State Treasurer Marden of Massachusetts has to say. Mr. Marden being fully qualified from his long connection with the fiscal department of his state to assert a thing, it is worth remembering when he says that "brokers who are now tumbling over each other to buy municipal bonds at very high prices are likely to have to sell them at a loss, or, at best, without profit. When business revives, taxable bonds yielding only a trifle above 3½ per cent. will find a dull market. The return is too small. A municipality ought not to expect to get money under about 4 per cent., and times are better when rates of interest are not too low."

Some current bond quotations are herewith appended as indicating to interested parties credits commanded by various municipalities:

MUNICIPAL BONDS.

	Price.
City of Pueblo, Col., Gen. Fund 6s	113
County of Flathead, Mont., 20-year, Gold 6s	107⅝
City of Bartow, Fla., 20 year 6s	102
Williamsbridge, N. Y., Highway 6s	136¼
City of Bethany, Mo., Gold 6s	105⅞
Knightstown, Ind., 6s	111½
County of Park, Mont., Gold 6s	109¼
County of Fergus, Mont., Gold 6s	106
City of New Whatcom, Wash., Gold 6s	105⅝
School District of Brainerd, Minn., 6s	108⅝
City of Meridian, Miss., 6s	107¼
County of Bexar, Tex., Gold 6s	103⅛
City of Omaha, Neb., 5s	111
City of Jefferson, Ia., 5s	102½
City of Hastings, Neb., 5s	102
City of Salt Lake, Utah, Gen. Fund 5s	103¼
City of Tacoma, Wash., 20-year 5s	101
City of Dayton, O., School 5s	107½
County of Portage, Wis., Refunding 5s	107¾
City of Findlay, O., School 5s	105
City of Sheldon, Ia., School 5s	101½
City of Brooklyn, N. Y., Pub. Market 4s	110¼
City of Elmira, N. Y., 4s	105⅝
City of Niagara Falls, N. Y., Sewer 4s	105½
City of Auburn, N. Y., 4s	108⅞
City of Cleveland, O., 4s	104⅝
City of Manchester, N. H., 4s	106½
Town of Methuen, Mass., 4s	107
City of Waterbury, Conn., 4s	105½
City of Chicago, Ill., Gold 4s	104¼

RAILWAY STOCK MARKET.

New York, July 17, 1894.

The attempt of the American Railway Union to run the railways of the country to suit the self-profitable ideas of Messrs. Debs, Howard, Sovereign and their colleagues has come to its inevitable end. Law and order have triumphed over anarchy and revolution, and the situation is again freed of that factor of labor disturbances inaugurated by the big bituminous coal miners' strike. With the outlook now cleared, it may be well to attempt from current conditions to make some little diagnosis as to the future of the railway stock market.

Ever since the ultimate failure of the strikers' cause, to dignify the insane movement by such a name, was made patent, railway stocks have held with a steadiness remarkable to those who have failed to notice Wall Street's habit of immediately discounting influences ,good or evil. Following on this firmness of quotations there has come, together with the practical end of the strike, a growth of hopeful sentiment that argues much for a recovery in prices. The steadiness of the market in the face of bad news, the present knowledge that the disturbing features so long threatening are being rapidly removed, the excellent crop prospects, better conditions abroad and, above all, an entire release from the fears engendered by the continuance in the West of riot and lawlessness, all combine to make an immediate recovery in prices after weeks of depression a natural consequence to existing conditions. That the advance at hand will be permanent is not so probable. When one considers the demoralization of business existing in every department of commerce as a result of the protracted labor disturbances, and the unwillingness of capital, until the labor situation is definitely cleared up, to engage in new enterprises—a circumstance that really makes activity in stocks—a sustained rise in values would be surprising to most students of the situation. But an advance of some little force is quite within the range of probability.

Of course earnings have been in many instances reduced to almost nothing. To judge of the business done by the railroads, it is well to look at the record of eastbound shipments from Chicago for the week ending Saturday last. In all 4,142 tons were forwarded, against 11,060 the week before, and 50,257 tons during the same week last year. The Michigan Central carried 792 tons, Lake Shore 683, Fort Wayne 570, Pan Handle 1,991, Big Four 106 and the other trunk lines nothing. Freight bound for Western points was just as much interfered with. Next month will see the worst effects of the strike, when the Rock Island and Burlington roads will likely cut the dividends, then due, by reason of the big losses in earnings incurred during the strike.

Of the influence of labor troubles on Europe's investors, President Depew is quoted as saying: "The effect of the strike abroad is important. It will certainly withhold foreign investments from this country. It will likewise cause much wonder and comment over economic conditions in a country where one man can, by sending a few telegrams, cause such a paralysis of business as we have lately seen, a state of affairs which made it necessary for the President to issue a proclamation which virtually declared an insurrection."

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices July 17.
Alton & Terre Haute	33
Atchison, Topeka & Santa Fe	5¼
Baltimore & Ohio	72½
Canada Southern	49¼
Chesapeake & Ohio	16¾
Chicago, Burlington & Quincy	75⅝
Chicago & Northwestern	105
Chicago, Milwaukee & St. Paul	59⅞
Chicago, Rock Island & Pacific	67½
Clev., Cin., Chicago & St. Louis	37
Delaware, Lackawanna & Western	163¾
Delaware & Hudson	130
Lake Shore & Mich. South	130
Louisville & Nashville	45⅝
Missouri Pacific	27
Missouri, Kansas & Texas	13½
Mobile & Ohio	18
New Jersey Central	106¼
New York Central	97½
New York & New England	6
N. Y., New Haven & Hartford	177
N. Y., Chicago & St. Louis, 1st pfd	60
N. Y., Lake Erie & Western	14⅜
N. Y., Ontario & Western	15
N. Y., Susquehanna & Western	14¼
Northern Pacific	3¾
Northern Pacific, pfd	14¾
Philadelphia & Reading	17¾
Richmond Terminal	12¼
St. Paul & Omaha	36⅝
Southern Pacific	18¼
Texas Pacific	8¾
Union Pacific	16⅝
Wabash, pfd	14¼
Wheeling & Lake Erie	10

BOSTON RAILWAY STOCKS.

	July 17.
Boston & Albany	206
Boston & Maine	146½
Fitchburg	69
Old Colony	179

PHILADELPHIA RAILWAY STOCKS.

	July 17.
Lehigh Valley	37½
Pennsylvania Railroad	49